Sciothericum Teleſcopicum;

OR,

A New Contrivance of Adapting a TELESCOPE TO AN Horizontal Dial

FOR OBSERVING

The moment of Time by Day or Night:

Uſeful in all *Aſtronomical Obſervations*, and for Regulating and Adjuſting

Curious *Pendulum-Watches* and other *Time-Keepers*, With proper *Tables* Requiſite thereto.

By *William Molyneux* Eſq; *Fellow* of the *Royal Society*, and of that in *Dublin*.

DUBLIN,

Printed by *Andrew Crook* and *Samuel Helſham*, at the *Printing-Houſe* on *Ormond-Key*; and are to be ſold by *W. Norman* in *Dame-ſtreet*, and *S. Helſham* and *El. Dobſon* Bookſellers in *Caſtle-ſtreet*, 1686.

TO HIS
EXCELLENCY
Henry Earl of Clarendon,
LORD Lieutenant General,
AND
GENERAL GOVERNOUR
OF
His MAJESTIES Kingdom
OF
IRELAND.

THe great Honour Your Excellency *was pleaſed to ſhew Our Society in accepting Our Congratulation at Your happy Arrival and Settlement in the Government of this* Kingdom, *and in giving us Your Incouragement in proſecuting our* Philoſophical Deſigns, *does neceſſarily require from us all poſſible* Returns *of Gratitude. And though what I now Preſent* Your Excellency *may ſeem unfit to begin withal, yet I could not omit this* opportunity *of expreſſing to* Your Lordſhip *the deep ſenſe I have of* Your Favours *to us, and to* Philoſophy. *And certainly, my Lord,* True Philoſophy *does highly deſerve Encouragement from the* Wiſe, *the* Great, *and* Powerful; *the moſt* Learned Univerſities *have at all times made* Natural Philoſophy *and* Mathematicks *a great Branch of their* Literature, *and we ſee how univerſaly* Academick Knowledge *has been approved of by the great* Encouragement *and large* Priviledges *the* Schools *have received from our* Wiſeſt Princes, *and by the general agreement of the moſt* ſober *and* conſiderate men, *in ſending their Youth to receive their* Education *therein. This ſhews how univerſaly* Philoſophick Learning *has been approved; and the only Queſtion that can be raiſed at preſent is, Whether the* Natural Philoſophy *formerly profeſsed in the* Schools, *or that which is at preſent proſecuted by the* Societies *lately* Inſtituted *in ſeveral the moſt noted parts of* Europe, *be the* True Philoſophy, *or method of* Inveſtigating Nature. *But ſurely this will be no longer a doubt, when we conſider how unſatisfactory were the* ancient Notions of Philoſophy, *which then conſiſted rather in* Diſputes, *and* Verboſe *empty* Stuff, *than in any Curious Diſcovery of* Natures Actions. *If a man could prove* Pro *and* Con, *whatever was propoſed, and main-*

tain this Diſpute *for two or three hours by vain* Diſtinctions *and idle* Evaſions, *he preſently gain'd the Name of a* Philoſopher, *tho all the while he had no manner of* Notions *in his Brain anſwerable to thoſe ſenſeleſs words he threw out. I would fain know, what* Notion *any man has of* Light *upon pronouncing the* definition *of it,* Actus Perſpicui quatenus Perſpicuum, *does he hereby in the leaſt underſtand any of the* properties *of* Light, *or how 'tis affected by* Refraction *or* Reflection? *or does this* Definition *lead him to improve* Light *for the advancement and help of our ſenſes, or other* advantage *of* mankind? *And now,* my Lord, *if this kind of* Philoſophy *which formerly fill'd our Schools were look'd upon as deſerving the* Favour *of the* Great, *how much more ſhall the preſent uſeful* Enquiries *of the* Ingenious *deſerve* Incouragement? *But that this may be made a little more evident (though I am perſwaded 'tis ſufficiently manifeſt already to* Your Excellencys *Diſcerning Judgment) I ſhall crave leave to be more particular in this matter; And I ſhall begin with one of the moſt Conſiderable and Univerſal Concerns of* Mans Life, *I mean* Navigation, *wherein the* Philoſophy *of the* Moderns *has been very much Exerciſed; The* Magnet *by its* Caprichious *Variations is at preſent in ſeveral parts of the World rendred almoſt uſeleſs; but diligent ſearch is daily made after its* Vagarys, *that we may not be deprived of the unſpeakable benefit of one of the moſt ſurpriſing* Phenomenas *in Nature. Certainly men might* *have Diſputed from Age to Age of* Sympathy, Antipathy, *and the* Occult Qualities *of the* Loadſtone, *before they ſhould ever arrive to the* Knowledge *or* Rectification *of one of theſe* Exorbitances, *which diligent* Experimental Philoſophy *preſently diſcovers, and further Experiments may hope to Rectify.* In relation *likewiſe uo* Navigation *are all the Enquiries into the* Theory *of the* Tides, *and the* Moons motion, *all the Endeavours for the* Longitude, *and the Diligence uſed to Rectify* Aſtronomy. *The* Philoſophy *of* Hydraulicks *and* Hydroſtaticks *tends to the great* Emolument *and* Pleaſure *of Mankind, no place being habitable without Water, and Curious Fountains adorn the Gardens and Houſes of the Greateſt Princes.* Agriculture, *and the* Philoſophy *relating to Earth and* Vegitation, *is of univerſal extent over the face of the World; and how mightily it has been lately proſecuted, is evident from the Incomparable Works of Mr.* Evelyn *and others. By the* Doctrine of Light, *and the Properties thereof, our moſt Noble Senſe has been Improved to an Acuteneſs ſome thouſands of degrees beyond its natural Abilities; and the* Teleſcope *and* Microſcope *diſcover to us new* Worlds *and* Animals, *extending the Creation farther than 'twas poſſible for the Ancients to imagine. There is no ſtate of Life that is not concern'd in* Meteorology, *or the* Philoſophy *of the* Weather. *And all that have heard of the late contrived* Baroſcopes, Hygroſcopes, Thermoters, *&c. may plainly perceive what Endeavours have been made towards it, and their ſucceſs.*

I might proceed on, and fill a Volume with Inſtances to Your Excellency *of the uſefulneſs of an Active* Experimental Philoſophy, *but I ſtop my hand, and ſhall only declare in ſhort, that from this alone we are to expect advancements in the moſt important concerns of humane life; the Virtues of* Animals, Plants *and* Minerals *for the health of mans Body,* Architecture *Civil and Military for the pleaſure and ſecurity of his life; all kind of* Machines *and* Movements *for the increaſe and due application of his ſtrength, proceed from this kind of* Philoſophy, *which conſiſts in Actions, not in Words, and proſecutes and ſometimes* improves Nature *by the ſame ſteps that ſhe her ſelf acts by. And indeed, my Lord, if we conſider* Nature *as an Active Principle, we muſt needs acknowledge that ſhe is to be proſecuted by* Action, *and not by* Verboſe Diſputes; *There is nothing that the mind of man will not find ſomething to ſay for or againſt all day long; and therefore of the School-Diſputes there is no end; but Experiment is matter of Fact, and ſtrikes the Senſes ſo forcibly, that there is no oppoſing it. Who is it that will now queſtion the force of* Gun-powder, *or whether the* Mercury *riſe and fall in the* Baroſcope *at fair or foul Weather?*

'Tis therefore this Philoſophy (may it pleaſe Your Excellency) *that deſerves* Favour *and* Incouragement *from the* Powerful *and* Wiſe; *and as God has made all things in* number, meaſure, *and* weight, *that* Learning, *which teaches us the affections*

of number *and* meaſure, *as being the Foundation on which* true Philoſophy *is to be ſuperſtructed, is chiefly to be reſpected. There is no part of* Philoſophy *wherein the* Mathematicks *are not deeply ingredient, and on them depend the* Arts of War *as the* Delights of Peace, *and even Sacred* Theology *it ſelf is in a great meaſure beholding hereto for its help, if we conſider how far the* Chronology *of the* Holy Scriptures *is help'd out by* Aſtronomy, *and the Doctrine of* Eclipſes.

And as I have preſumed to detain Your Excellency *thus long, in declaring how* true Philoſophy *deſerves Your* Protection, *ſo give me leave to add one word more in declaring how* Your Excellency *deſerves the* Tutelage *of true* Philoſophy. *Your* Illuſtrious Father, *of Happy Memory, was no unactive* Speculative Philoſopher, *but was zealous and forward in promoting the Noble Deſign of the* Royal Society, *as appears to his immortal Praiſe in their* Incomparable Hiſtory, *and by their Electing him, and his willing Complyance to be their* Protector. *Neither did he only countenance* Philoſophy *by his* Authority *and* Favour, *but actually drew the Sword in its defence againſt the great* Sea Monſter *that would have deſtroy'd the* Virgin; *as is manifeſt from his* Learned *and* Ingenious Treatiſe *againſt the* Leviathan. *All the World that know* Your Lordſhip, *muſt acknowledge that this and other his extraordinary* Virtues *are entail'd on* Your Excellency, *who has not buried the* Talent *in a* Napkin, *but improved* *it to an high degree.* Your Excellency *has Honoured the* Royal Society *by being one of their Number, and their* laſt years Council *was compleated by* Your *being one of them. So that upon all occaſions* Your Excellency *has ſhewn* Your Self *a zealous* Patron *of* Learning *and* Ingenuity ; *and though I dare not on either ſcore challenge* Your Excellency's Protection *of what I here preſent You, for I am afraid to truſt my own Judgment in my own Concern ; yet I will preſume to implore* Your Favour *towards it as 'tis new, and not diſliked by ſome* Ingenious Men *to whom I have ſhewn it. Whether it may deſerve* Your Excellency's *Countenance for its Uſe and Advantage, I leave to Your own diſcerning Thought, after* Your Lordſhip *is pleaſed to conſider what I offer in the Firſt and* Second *Chapters. However, this I will venture to aſſert before-hand, that as* Clocks *or* Time-keepers *by Wheels and Weights have been an ancient Invention, (if we believe* Severinus Boethius *to be the firſt Author of them, 'tis above* 1100 *years ago) yet in theſe later days they have received a moſt high advancement (to the immortal glory of* $\text{M}^{\text{nſr.}}$ Hugens) *by the addition of a plain and ſimple* Swag *or* Pendulum ; *ſince the days of* Hezekiah, *wherein we firſt find* Dials *mentioned, I have not heard of a more plain and eaſy addition for the advancement of* Dials, *and inlarging and aſcertaining their Uſe, than what I here propoſe. And though I ſhall not be ſo vain, as to expect its ſudden propagation, or any great Glory from the Contri-*

vance, yet if I can be ſo happy as thereby to Divert and Pleaſe Your Excellency, *and in ſome meaſure to purchaſe Your Favour, 'tis the higheſt Ambition of*

Your Excellencies

Dublin, April 17. 1686.

Moſt Obedient Humble Servant,

WILL. MOLYNEUX.

Sciothericum Teleſcopicum,

OR,

A New Contrivance of Adapting a Teleſcope *To a large* Horizontal Dial, *for obſerving the moment of Time by Day or Night.*

CHAP. I.

The Uſe and Advantages of this Contrivance.

EVery one the leaſt verſed in *Aſtronomy*, does know of what great Concernment the *Obſervation* of the exact Moment of Time is therein. Without this no Celeſtial *Obſervation* can be performed *Accurately*, and *Aſtronomy* is like to receive but little advancements. Hereby the *Tables Aſtronomical* are approved or rejected, and Calculations found true or falſe. So that whatever advantages we propoſe to our ſelves by a Correct *Aſtronomy*, we ſhall find our preſent Indeavour to be helpful towards them. And certainly there are ſome ſignal uſes expected from it, ſince ſo many *Kings*, *Princes*, *States*, and Learned Men in all *Ages*, particularly our late and our preſent *Soveraign* of *Great-Brittain*, The preſent *French King*, and formerly ſome Kings of *Denmark*, have been at ſuch great expences both of *Time*, *Labour*, and *Charges*, for the advancement thereof. But I ſhall paſs by all other excellent uſes that are expected from an *Accurate Theory* of the motions of the *Heavenly Bodies*, and ſhall only inſiſt on one particular, wherein the *Obſervation* of the exact Moment of *Time* does more immediately tend to the uſe of mankind. We all know how univerſaly the whole World is concern'd in *Navigation* and Commerce, by *Ships* flying before the winds, and floating on the *Seas*; *Nation* converſes with *Nation*, as every man with another by words flying in the *Air*; by this, Civility, Learning, and all Politeneſs is propagated; we are made acquainted with one anothers *Laws*, *Conſtitutions* and *Manners*, we mutually reap the *Fruits* of each others *Countrys*, and are no longer Strangers, but *Fellow-Citizens* of the World. And for all theſe advantages (at leaſt for our more ſecurely reaping theſe benefits) we are in a great meaſure, if not wholly, beholding to *Aſtronomy*. For whoever has but inquired into the firſt Rudiments of that *Science*, does very well know, how far the determination of the *Longitude* of places, and conſequently the advancement of *Geography* and *Navigation* depends thereon. But whether this be attempted by *Eclipſes* of the *Sun*, *Moon*, or *Stars*, or by the *Immerſions* and *Emerſions* of *Jupiter's Satellits* into or from his ſhadow, or by the *Pendulum Clock*, at *Sea*, &c. In all theſe methods the *Obſervation* of the exact Moment of time is neceſſary, for otherwiſe the *Horary* diſtance of the place of *Obſervation*, and conſequently the diſtance on the *Æquator*, or *Longitude*, from an aſſigned place ſhall be uncertain.

CHAP. II.

Of the Methods uſed for obſerving the Exact Moment of Time, and their Inconveniencies and Troubles.

THE common ways uſed by *Aſtronomers* for obſerving the *Time* are, either by *Dials*, or by taking the *Suns Altitude* by day, or by the *Altitude* of fixt *Stars* by night, taken by large and accurate *Inſtruments*; or by obſerving the *Altitude* and *Azimuth* of the *Sun* or *Stars*, or laſtly by the *tranſits* of *Sun* or *Stars* croſs the *Meridian*, or the coming of ſome of the *Circum-Polar Stars* in the ſame *Vertical* with the *Pole-Star*. All theſe methods have their inconveniences, or at leaſt, are attended with far greater trouble than that which I ſhall propoſe.

And firſt for *Dials*, unleſs they be very large they will not admit of diviſions ſo minute, as are requiſite to the nice determination of the Time, as into minutes, half-minutes, and quarter-minutes. And when they are ſo large as to admit ſuch, the uncertain ſhadow that is caſt from a long

Gnomon renders them uſeleſs for ſuch niceneſs; for though your *Dial* have on it every quarter-minute, the moſt accurate eye cannot tell where the ſhadow determines to a minute. Another grand defect of *Dials* is, that they ſerve only in the day-time, and that too, when the Sun ſhines out intenſely. So that for the night (which is the chief time of *Aſtronomical Obſervation*) *Dials* are perfectly uſeleſs.

Perhaps I need ſay no more to recommend my preſent contrivance, then to aſſert that it clearly takes off both theſe inconveniences. For thereby the larger the *Dial* is, and the more minute the diviſions are, the more accurately is the Time obſerved. A long *Gnomon* in our way hinders not at all, nor is there any uncertainty from a *Penumbra*. And moreover 'tis adapted as well to ſerve by the Stars at night, as by the Sun in the day, and gives the hour almoſt by inſpection at a Star, as at the Sun. And withal has this advantage, that when the Sun is over-clouded, ſo as but juſt to be ſeen faintly, and caſts no ſhadow at all on a *Dial*; yet in our way, if he be in the leaſt perceivable by the eye, the Time may be exactly told by him.

I cannot ſay that there are inconveniences in obſerving the Time, by taking the Sun or Stars *Altitudes* and *Azimuths* by day and night; and yet if we reckon trouble an inconvenience, theſe methods are not free from it. For, beſides the difficulty and charge of obtaining Inſtruments large and accurate enough for doing theſe, and the dexterity and long practice that is requiſite for rightly managing them: This method is attended by the trouble of Calculating the moſt difficult of oblique ſpherical Triangles, *viz.* that wherein three ſides are given to find an *Angle*; and this, if the obſervation be by the *Altitude* of the Sun in daytime; for by the *Altitudes* of Stars by night, the Calculation is yet more tedious and troubleſome. And if ſo, what a toil muſt it be to ſuppute twenty or thirty of theſe in a night? Beſides, the *Altitudes* of the Sun towards the *meridian* alter ſo ſlowly, that for a good while both before and after noon, 'tis not ſafe to rely upon them. This inconvenience indeed is ſomething remedied at the Stars, where I can chooſe thoſe that are of a proper *Altitude*, and conveniently remote from the *Meridian*, and the obſervation of the *Azimuth* remedies the other uncertainty proceeding from their *vicinity* to the *Meridian.* But, as I ſaid before, the trouble of Calculation attends the obſervation either of *Altitudes* or *Azimuths*; whereas the Inſtrument I propoſe, does the matter with the greateſt certainty, and greateſt eaſe imaginable. There is requiſite therein, beſides a plain and ſimple obſervation, no Calculation by *Triangles*, or any other Operation, ſave only the addition and ſubſtraction of two or three ſmall numbers, to be had in the

Tables ready Calculated; and that too, only when the obſervation is by the Stars at night.

The methods of obſerving the Time by the *appulſes* of the Sun or fixt Stars to the *Meridian*, or the *Circum-Polars* coming in the ſame *Vertical* with the *Pole*, are plain, ſimple, and eaſy. We have the firſt deſcribed by *Riccioli* in his *Almageſtum Novum*, *Lib.* 5. *Cap.* 15. *Prob.*8. where he ſhews us how to perform it by his *Triangulum Filare*. The latter way is deſcribed by Sir *Jonas Moore* in his *Compendium Mathematicum*, *p.* 118. and more fully in the Royal Almanacks for the years 1676, 1677, 1678. And I have by me Tables laboriouſly and carefully Calculated by my eſteemed Friend *Henry Osburn* Eſq; an excellent Aſtronomer and Mathematician for *Dublin* and other *Latitudes* in *Ireland* to years lately paſt, and to come, which are to be uſed in this way. But, though both theſe ways (as I ſaid before) are very plain and eaſy, yet they ſerve rather to rectifie Watches and other Time-keepers, then to ſhew the Time themſelves throughout the whole courſe of an obſervation; as, ſuppoſe it were an Eclipſe of the Moon, perhaps when a ſpot either immerges or emerges into or from the ſhadow, there is not at that very inſtant, and perhaps will not be for many minutes after, a Star in the *Meridian*, or under the *Pole-ſtar*, to tell me the moment of that time.

But what I propoſe does as conſtantly (and not by fits) ſhew, and follow the time, if duly managed, as the Hand of a well-going *Pendulum-Watch* indicates the hour; that is to ſay, it tells you the preſent minute, and quarter of a minute, whenever you are pleaſed to look, as well as any other, paſt, or to come.

CHAP. III.

A Deſcription of the Inſtrument.

THe contrivance of this Inſtrument conſiſts in making a very large *Horizontal Dial*, adapted to your proper *Latitude*, and capable of receiving diviſions into minutes, and parts of a minute, fitted with a large, ſtrong, and double *Gnomon*; I call that a double *Gnomon* that caſts the morning-ſhadow from its Weſtern-edge, and the afternoon-ſhadow from its Eaſtern-edge, and the noon-ſhadow by its thickneſs. This *Dial* is to be furniſhed with two pair of Sights or Rulers; one to ſerve in the morning, or for Stars on the Eaſtern-ſide of the *Meridian*, t'other to ſerve in the afternoon, or for Stars on the Weſtern-ſide of the *Meridian.* Each of theſe pair conſiſts of two movable Rulers, one I will call the *Horizontal-Ruler*, t'other the *Gnomonick-Ruler*, or *Stile-Ruler*. Theſe two Rulers are to be ſo adapted, that their two edges that are next the *Gnomon*, may be perpetually in the ſame plane with each other, and at the time of obſervation, that they both may be in the ſame plane with their correſpondent edge of the *Gnomon*. On the *Stile-Ruler* are fixt Teleſcopick Sights, and the croſs hairs in their due place. But all this will be made plainer by the firſt Figure, in which I ſhall repreſent that Inſtrument which by my directions was made in *London* in the Summer 1685 by *Richard Whitehead* Math. Inſt. Maker, who took the directions from my ſelf, but made the Inſtrument in my abſence.

The firſt Figure repreſents the Inſtrument in Perſpective, having one pair of its Rulers in a poſture of obſervation; t'other pair lying careleſly on the plane of the *Dial*. 'Tis a large Octogonal Braſs-plate, clear'd in the middle, except only the croſs-bars *z z z* of the ſame piece with the Plate, left for ſtrengthning the Inſtrument, and receiving the Stile, the Plate is of a moderate thickneſs about $\frac{15}{100}$ of an inch, the Diameter of the largeſt circle it receives is 18 inches, 'tis ſupported from the plane on which it ſtands about three quarters of an inch by three braſs-feet 2. 2. 2. the bredth of the limb for receiving the Figures and Diviſions, is $2\frac{1}{2}$ inches. The thickneſs or bredth of the face of the Stile *m a l b* is $\frac{7}{10}$ of an inch. The Diviſions actually expreſſed upon it are hours, half hours, quarters, five minutes, minutes, and half minutes, and one may eaſily judge of the third part of an half minute, that is, 10 ſeconds. Down along the face of the Stile (ſome perhaps will call it the back of the Cock) there runs a deep Groove, to receive the ſcrew *m. l.* which ſcrew, by turning the handle *n*, raiſes and lets down the Nut *op*, on which the Stile-Ruler *e f* reſts, and is thereby raiſed and let down, as the Sun or Star requires. This Nut *op* is furniſh'd with a Return'd Fork, meerly to keep the Stile-Ruler from an accidental fall, if any thing ſhould chance to move it rudely. But I ſhall deſcribe this Nut *o. p.* preſently by it ſelf. The ſcrew *m. l.* is fixt both at top *m* and bottom *l*, ſo that it only is to be turn'd round by the handle *n.* the Stile is fixt moſt ſtrongly by the ſcrews, *q. r.* I come next to deſcribe the Rulers, and firſt for the *Horizontal* Ruler *c d*, this turns moſt truly upon the Center of the hour-lines and diviſions at *k*, and has ſo much of the root of the Stile clear'd off, as its thickneſs requires to permit its motion freely; the line *c d* of this Ruler croſſes the Center moſt exactly, and the edge *c d* is neatly cypher'd off (as the Workmen call it.) Wherefore the right line *a b* of the Stile, and the line of the under-edge of the *Horizontal Ruler c d*, meeting, and croſſing perpetually in the ſame point *k*, they ſhall be always in the ſame plain, (by *Prop.* 2. *Eucl.* 11. Book.)

To the other end of this *Horizontal Ruler* there is adapted the Stile-Ruler *e f*, which by means of the joynt *v x y* (which I ſhall deſcribe by it ſelf) obeys two ſeveral motions, *viz.* one upwards and downwards, as govern'd by the Nut and ſcrew on the Stile; and t'other Eaſtward and Weſtward, according to the *Azimuth*, or as it follows the *Horizontal* Ruler. And in theſe two motions, 'tis ſo contrived, that the line *c d* and *e f* may perpetually croſs each other in one and the ſame Center at *y*. Hence it comes to paſs, that the right line *c d*, and the right line *e f*, are always in the ſame plain. Wherefore laying the line *e f* to the edge of the Stile, the three lines *a b*, *c d*, *e f*, are in the ſame plain; and conſequently directing the line *e f* to the Center of the Sun, the edge of the *Gnomon*, and the edges *c d* and *e f* of the Rulers are in the plain of the ſhadow; and therefore the Ruler *c d* cuts the diviſion on the limb of the Dial-Plate, where the ſhadow would cut it.

To the Stile-Ruler are fixt, the Eye-glaſs at *h*, the Ring that carries the croſs hairs at *g*, and the Object-glaſs at *i*; The manner of adjuſting all which, I ſhall ſhew preſently.

But I muſt not forget to mention the Artificer, whoſe hands were imploy'd in this Inſtrument, Mr. *Richard Whitehead* living in *Gunpowder-Alley* in *Shoo-Lane*, by *Fleetſtreet*, *London*, a moſt exact and careful Workman, of whoſe skill and curioſity in making Mathematical Inſtruments, I have more than this one inſtance; And I dare venture to recommend any Gentleman to him, as a moſt exact performer.

CHAP. IV.

Of the Stile-Nut, and Ruler-Joynt.

IN the foregoing Chapter I have promiſed a particular deſcription of ſome of the forementioned parts belonging to this contrivance; and firſt of the Nut *op* (*Fig.* 1.) This I have repreſented by it ſelf in *Fig.* 2. *s s* is the Stile-ſcrew paſſing through the Nut *n*, which is lined with a female-ſcrew; this Nut ſlides in the Groove along the face of the *Gnomon*, ſo that the whole thickneſs of the ſcrew lies under the ſaid face. *p p* are two arms that claſp the Stile to make the motion of this Nut more even and ſteady. *f a b* is the Return'd Fork to keep the Rulers, when they are ſupported on this Nut, from any accidental fall, and is very uſeful when the *Horizontal* Ruler is removed far from the *Meridian*: And leaſt at any time, either of the Returns *a b*, may ſtand in the way of either of the Rulers motions, the parts *a b* are movable at *a* by a riveted joynt, and may be turn'd clearly downward out

of

of the way, as at *a c*, *a c*. At *a* there may be fixt a ſmall gentle ſpring, that may lightly bear the edge of the Ruler conſtantly to the edge of the Stile; but this contrivance is not on my Inſtrument, though it may be eaſily added.

The ſeveral parts of the Ruler-joynt (which indeed is the moſt curious piece of Mechanicks about the whole Inſtrument, and on which the whole affair does chiefly depend) are repreſented all apart in Figures by themſelves. *Fig.* 3. ſhews the outward end of the *Horizontal* Ruler, *a a a* are the holes that admit the ſcrews which faſten it to the other parts of the joynt, particularly to the ſocket ſhewn in *Fig.* 5, 6, 7, 8. at *a a a*. *Fig.* 4. ſhews the other end of the *Horizontal* Ruler, where it turns on the Pin in the Center of the Dial at the root of the Stile (at *k Fig.* 1.)

Fig. 5. expreſſes the appearance of the joynt, when diſcover'd of *Fig.* 3. , *i h i* is a perfect hinge, the Center of whoſe motion is in the line *f h*, *i i i* that part of the hinge belonging to the Ruler, *h h h* that part belonging to the Tumbler or Nut expreſſed in *Fig.* 7. *h h h*. *a a a* the ſocket wherein the Tumbler *h h h* moves round and truly on the Center at middle *h*, which alſo is in the Center of the hinges motion. This ſocket *a a a* is repreſented in *Fig.* 8. *b b* are the ſcrew-holes for the Ring and Snout of the Eye-glaſs.

Fig 6 ſhews the under-ſide of *Fig.* 5. where the ſame parts are marked with the ſame letters; *c* is the round Pin of the ſame piece with the Nut *bbb*: This is more plain in *Fig.* 7, this Pin turns truly in the hole of the ſocket *c* in *Fig.* 8. whilſt the Nut *b b b* of *Fig.* 7. reſts and turns on the bottom of the ſaid ſocket *b b b Fig.* 8. This Nut is kept cloſe in the ſocket, and there made to move ſteadily and truly by the Pin *e* and ſpringing Plate *d Fig.* 6. and 9. which Pin *e* paſſes over the Plate *d* through the Pin of the Nut *c*.

CHAP. V.

Of the Teleſcopick Sights, and their true Adjuſting.

FOr the true adjuſting of the *Teleſcopick* Sights *h g i* (*Fig.* 1.) to the Stile-Ruler *e f*, there are three things requiſite. But firſt I muſt advertiſe, that the Stile-Ruler *e f* ought to be ſo ſtrengthned, that as it reſts on the Nut *o p*, it may not at all bend, but that the line *ef* may be one right line as nigh as poſſible. But in this particular the greateſt niceneſs is not requiſite, for if the Ruler chance a little to deviate from its exact ſtraightneſs, I ſhall ſhew a way of rectifying the error by the croſs-hairs or *Menſurator*.

The firſt thing requiſite to the placing of the *Teleſcopick* Sights is, that the ring *g*, that carries the croſs-hairs or other *Menſurator*, be at a due and exact diſtance from the Object-glaſs *i*. This diſtance is to be exactly the total length of the Object-glaſs; but that we may get this total length more accurately than by any admeaſurement, the Eye-glaſs and Object-glaſs being adapted together, and placing the *Menſurator* in the ring *g* between the Object-glaſs and Eye-glaſs at the diſtance of the *Focus* of the ſaid Eye-glaſs, let us look at ſome object diſtant 4 or 5 miles, and moving your eye before the Eye-glaſs, obſerve whether the *Menſurator* ſeems to move upon the ſaid object; for if it do, then the *Menſurator* is not at its exact diſtance from the Object-glaſs, but the Object-glaſs is to be removed farther or nigher, till the eye looking at ſuch a diſtant object, and moving before the Eye-glaſs, perceives the *Menſurator* as it were fixt and immovable on the object. If in raiſing the eye, the object ſeem to fall down on the *Menſurator*, or in depreſſing the eye, the object ſeem to riſe on the *Menſurator*, then is the Object-glaſs too nigh the *Menſurator*. But if in raiſing the eye, the object ſeem to riſe on the *Menſurator*; or in depreſſing the eye, the object ſeem to fall on the *Menſurator*, then is the Object-glaſs too far from the *Menſurator*. All which will be evident from the 10 *Fig.* wherein let *A B* be a diſtant object, whoſe middle point *C* is projected by the Object-glaſs *D* at *k*, let *m n* 1 be the *Men-*

ſurator to which the Object-glaſs is too nigh, and *m n* 2 the *Menſurator* from which the Object-glaſs is too far, *e*, *f*, *g*, the eye placed at three different poſtures; in caſe of the firſt *menſurator*, if the eye riſe from *e* to *f* it perceives the point *k* depreſſed from 1 to *h*; or if the eye fall from *e* to *g*, it perceives the point *k* raiſed from 1 to *l*; and here the *menſurator* is too nigh the Object-glaſs. But in caſe of the ſecond *Menſurator*, if the eye riſe from *e* to *f*, the point *k* ſeems to riſe on the *Menſurator* from 2 to *r*; or if the eye fall from *e* to *g*, it perceives the point *k* fallen from 2 to *s*, and in this caſe the *Menſurator* is too diſtant from the Object-glaſs; but if the *menſurator* be exactly in the *Focus* at *k*, let the eye riſe or fall, the *menſurator* ſeems fixt and ſteddy upon the object. And this is the firſt thing requiſite to the adjuſting of theſe Sights.

This Affair is uſually ſo well adjuſted by the Workmen, and when once adjuſted, is never alterable, that I need ſhew no way of providing for it. But in ſhort, it may eaſily be provided for, by making the holes for the ſcrews, that fixt the Object-glaſs-ring to the Stile-Ruler, long ſlits, ſo as to ſlip forwards and backwards on the necks of the ſcrews; and when the Object-glaſs is at its right poſture, the ſcrew-heads may pinch and fix the Ring ſteddily.

The next requiſite is, that the line of *Collimation* from the *menſurator* through the Object-glaſs, and ſo to the object, run parallel to the line *ef* of the Stile-Ruler. This *Parallelism* conſiſts in two manner of ways, firſt, that the *menſurator* be neither more to the right or left-hand than requiſite; or ſecondly, that it be neither higher or lower than it ought. The firſt error makes the *Azimuths* be ſhewn falſe, and the ſecond error makes the *Altitudes* be ſhewn falſe: but an *Horizontal* Dial tells the time by both *Altitude* and *Azimuth*; therefore both theſe are to be taken care of.

And firſt for the Fabrick of the Ring *g*, that carries the *menſurator*; this is ſo to be order'd, that firſt the Ring may be moved more to the right or left-hand, and there to be fixt; and ſecondly, that the *menſurator* may be raiſed or depreſſed according as is requiſite, and there fixt. The firſt is obtain'd by making the holes for the ſcrews, whereby this Ring *g* is fixt to the Stile-Ruler, long ſlits, ſo that they may ſlip on the necks of the ſcrews before the Eye-glaſs, and when they are in their right poſture, may be pinched cloſe by the ſcrew-heads, and there fixt. Thus therefore we give the *menſurator* a motion to the right or left-hand, by which 'tis brought to ſhew the *Azimuth* right, as I ſhall declare preſently. Next, that the *menſurator* may be raiſed or depreſſed, inſtead of croſs-hairs in the Ring *g*, let there be placed therein a very ſtrong Steel-needle, that may end in a moſt fine ſlender point: this needle is to be a ſcrew almoſt its whole length nigh to its ſmaller end, and to be ſcrew'd through the top of the Ring *g*, ſo that its ſmaller end may paſs through the center of the Ring; by ſcrewing or unſcrewing of this Needle, we depreſs or raiſe its fine point in the Ring. And thus much for the contrivance or Fabrick of the Ring.

I come now to ſhew the way of managing theſe two motions in the *Menſurator*, ſo as to bring it to its true poſture, and there fix it. And firſt for rectifying the *Menſurator* ſo as to ſhew the true *Azimuth*. There are two manner of ways for doing this. The firſt is more troubleſome and tedious, but being moſt univerſal to the fixing of *Teleſcopick Sights* on all *Rulers*, I ſhall here deſcribe it. In *Fig.* 11. let *ABCD* repreſent a *Ruler*, whoſe edge or ſide *AC* is exactly parallel to its ſide *BD*. To make a *Ruler* thus parallel, is not difficult to a good Artificer; but I ſhall ſhew how to try whether theſe ſides are parallel or not. *E* is the Object-glaſs, *F* the *Menſurator*, *G* the Eye-glaſs. On a plain Board ſtrike two round Braſs-pins, as ſuppoſe at *H* and *I*, to theſe apply the ſide of the *Ruler BD*, ſo as it may reſt againſt the pins, which are therefore not clearly buried into the Board, but ſtand out about $\frac{1}{10}$ of an inch: then look through the Glaſſes, and obſerve where the *menſurator* falls on an object diſtant a mile or two. Then remove the *Ruler*, and apply its other ſide *AC* to the other ſide of the pins *HI*, and obſerve whether the *menſurator* falls on the ſame point of the object as before. If it do ſo, then are the ſides of the *Ruler AC*, *BD* parallel; if not, then the ſides are not parallel. The reaſon that ſo remote an object muſt be choſen, is, that the bredth of the *Ruler* may ſubſend an inconſiderable *Angle* in a circle, whoſe *Radius* is the diſtance of the object. Having found the ſides of the *Ruler* to be parallel, the next thing is, to make the line of *Sight*, or line of *Collimation LK* parallel to theſe ſides, for therein conſiſts the firſt rectification of our *Stile-Ruler*. The method of doing this is much the ſame with what immediately precedes, but requires another diſpoſition of our pins; for now we are to raiſe our plain Board ſo as to ſtand edge-wiſe, nigh perpendicular to the *Horizon*, and the pins muſt ſtand an inch or more out from the Board, almoſt parallel to the *Horizon*; then reſting the under-ſide of the *Ruler* on the pins, and applying its edge to the plain Board, obſerve the point of a remote object whereon the *menſurator* falls; in this poſture the Glaſſes ſtand uppermoſt, or on the upper-ſide of the *Ruler*, and over-look the pins. Then remove the *Ruler*, and hang the other ſide thereof on the pins, that now the Glaſſes may be on the underſide the *Ruler*, or under-look the pins, and reſting the edge againſt the plain Board, obſerve whether the *menſurator* fall on the ſame point as before; if it do, then is the line of *Collimation LK* parallel to the ſides *AC*, *BD*; if it do not, but falls to the right-hand apparently of the ſaid object, then is the *menſurator* to be removed (by means of the ſcrews and ſlits in its Ring) to the left-hand: the contrary requiring the contrary. And thus by frequent repetitions and trials we at laſt bring all to rights. The moſt convenient Board or Table for this Operation, is a Surveyors Plain-table; for theſe being uſually made true,and readily and ſteddily obeying all motions and poſtures,and are eaſily fixt thereat; they are to be choſen before any other. Note alſo that the pins to be uſed with this or ſuch like Table, are to be ſtrong braſs-wire, which having its roundneſs from its drawing, is ſure to have its ſides parallel. By this method,the line of ſight of any *Cylindrical* or ſquare *Teleſcope* may be made to run parallel to its ſides, for finding the Declination of the *Magnet* according to the methods lately propoſed by *Monſieur Hauteſeville*, and *M*nſr. *Sturmius*, in the Journal *des Scavans* 23. *Aug*. 1683. and in the *Acta Lipſiæ*, *An.* 1684. *menſ. Decemb.* and for want of this method, what *M*nſr. *Sturmius* ſays in the foreſaid *Act. Lipſ. pag*. 579. is very defective. For thus he, *Sola tubi locatio ut axis viſionis per medias lentes excurrens meridianæ lineæ exacte reſpondeat difficultatis quippiam habere videbatur, verum & huic infirmitati præſens, uti*

credo,

credo, inventum eſt remedium, &c. And the remedy he tell us is, that the *Tube* be made a parallelipiped of Wood or Braſs; for then, ſays he, applying the ſide of your *Tube* to the *meridian line*, the *Axis* of *viſion* will be parallel to the ſaid *meridian line.* But I muſt crave leave to deny this, unleſs firſt it be rectified, ſo that this *Axis* runs parallel to the ſide of the *Tube*, which he was not aware of: and this is to be done by the method I have juſt now propoſed, which ſerves likewiſe in many other Occaſions, Experiments and Practiſes, wherein a *Ruler* with *Teleſcopick Sights* is requiſite.

The ſecond method for effecting this ſaid rectification, is more eaſily applicable to our *Dial*, and withal is ſufficiently accurate, as doing the buſineſs to 10″ or 15″ ſeconds of time at utmoſt, and by a careful and curious eye, may do it to half that or leſs. Place the *Dial* ſo before the Sun, that as nigh as poſſibly the eye can judge, the *Gnomon* may be equally enlightned on both ſides, that is, that the ſhadow of the Stile may fall exactly on 12 a Clock, or the *meridian line* of the *Dial.* This perhaps will be ſaid by ſome to be no fair proceeding, becauſe in this we cannot tell where the ſhadow does exactly determine, and that this being one of the inconveniences our *Dial* pretends to remedy, if we *rectify* our *Dial* by ſuppoſing we can determine *that*; & if afterwards we determine *that* by ſuppoſing our *Dial rectified*, it will ſeem a circle in *Argumentation*, but yet I ſay, they that will try it, will find it otherwiſe; for I can place the *Dial* ſo, that the ſhadow from the thickneſs of the Stile, or at leaſt the *Penumbra* from both the Stiles edges, ſhall ſo equally fall upon the 12 a Clock-lines, that $10''$ ſeconds of time, or leſs, ſhall ſenſibly alter the equality. And 'tis not the ſame caſe in telling when this ſhadow comes to an equality on both the 12 a Clock-lines, as in telling when the ſhadow of one of the ſingle edges of the *Gnomon* comes to any of the other hour-lines. For in the firſt caſe I am only to judge by compariſon, *when* the ſhadow is come as much to one of the 12 a Clock-lines as to th'other; but in the latter caſe I am to judge poſitively without compariſon. Wherefore having the *Dial* in this poſture, bring the *Horizontal* and *Stile-Rulers* juſt to 12 a Clock on the *Dial-Plate*, and obſerve whether your *Menſurator* divide the Sun equally into an *Eaſtern* and *Weſtern* half; if it do ſo, then is your *Menſurator* right; if not, the *menſurator* is to be moved ſomething to the right or left hand, as is requiſite, till at laſt by frequent repetitions and tryals we obtain our deſire. And thus much ſhall ſuffice concerning the rectification of the *menſurator* to the right or lef thand, ſo as to ſhew the *Azimuths* truly. I ſhall only take notice, that when one pair of the *Rulers* is rectified, the other pair is eaſily rectified by them; for bring the rectified pair to the 12 a Clock-line on the *Dial*, and move the whole body of the *Dial*, till you get the center of the Sun, or any Star on the *menſurator*, then immediately bring the unrectified pair of *Rulers* to the 12 a Clock-line on their ſide, and if the Sun or Star be not exactly on the *menſurator* on this pair, the *Menſurator* is falſe, and muſt be rectified, as is requiſite: but this being plain to the meaneſt capacity verſed in theſe matters, I ſhall inſiſt no longer thereon.

But I proceed to the other Rectification of the *Menſurator* for rightly telling the *Altitudes*, as I have ſaid before. And tho there be not ſo very great exactneſs required herein, eſpecially in telling the time by the Sun or Stars when nigh the *Meridian*; yet a groſs error herein muſt not be allow'd. This likewiſe is to be performed much after the ſame method with the former Rectifications, for 'tis but contriving ſome way for inverting the *Ruler*, ſo that its errors of this kind may be perceived, as by our former Inverſions we diſcovered the errors of another kind. But to make this a little more plain, this error conſiſts in the line of Sight not running parallel with the under-ſide of the *Ruler*; wherefore if we have (ſuppoſe) a *Deal-board* whoſe two faces are exactly parallel, and this *Board* be raiſed and fixt ſo as to lye ſteddily along one of its edges, and on each face of the Board there were a ledge to ſupport the Ruler; and the Ruler be applyed by its under-ſide to one face of the Board, and the object marked out by the *Menſurator*, diligently obſerved; and then the Ruler applyed by the ſame under-ſide to the other face of the Board: If the ſame object be now cut as formerly, ly, all is right; if not, the *Menſurator* (being ſuch as I have formerly deſcribed) muſt be ſcrew'd or unſcrew'd, ſo that the fine point thereof may be lower or higher in the Ring, according as is requiſite.

Another more eaſy way of diſcovering and rectifying this Error to ſufficient accuracy, is thus: After you have by the former methods brought the *Menſurator*, and thereby the *Ruler*, to ſhew the true *Azimuth*; obſerve the time by the *Dial* when the Sun is very far removed from the *Meridian*, as early in the morning; and at the ſame time obſerve by a good *Pendulum* Clock the hour, minute, and ſecond; and note the difference between the *Dial* and Clock. Proceed thus to make an obſervation every quarter of an hour through the whole morning, ſtill noting the differences: And becauſe we may well ſuppoſe that a good *Pendulum* Clock in ſo ſhort a courſe of time goes equally, theſe differences ſhould be always equal; but if they are unequal, then the *Menſurator* ſhews the *Altitudes* falſely. As for inſtance, ſuppoſe I find that approaching towards Noon theſe differences decreaſe, then does the *Menſurator* on the *Teleſcopick Ruler* ſhew the *Altitudes* too little, and therefore muſt be order'd ſo as to ſhew them more: if I find them increaſe, the contrary is to be done. The reaſon of this is plain, for an *Horizontal Dial* ſhews the time as well by the *Altitudes* as *Azimuths*; but as the time approaches towards Noon, the *Altitudes* are leſs concern'd in the matter than the *Azimuths*; and ſo leſs and leſs, till juſt at Noon the time is not at all ſhewn by the *Altitude*, but ſolely by the *Azimuth*. And conſequently, if there be any error in the time ariſing from a falſe *Altitude*, it will appear by comparing two times or more together; ſome, wherein the *Altitudes* are much concern'd, and others, wherein the *Altitudes* are little or not at all concern'd; but ſuch times are, early in the morning, and towards noon.

CHAP. VI.

The Way of Setting this Dial.

TO the true Setting of this *Dial*, there are two things requiſite; Firſt, that the plain of the *Dial* be in an exact *Horizontal* poſture, this is eaſily obtain'd by accurate levels, which are ſo common, that I ſhall mention nothing further hereof. The ſecond requiſite is, that the *meridian* or 12 a Clock-line of the *Dial* be in an exact *meridian* line. This indeed is one of the chief particulars that we are to take care of, for thereon depends the accuracy of the whole. But that we may not over-turn or neglect the whole affair for the difficulty of this one particular, I ſhall ſhew that this is no ſuch inſuperable hardſhip as may be imagin'd. Let us therefore consider, that what is here alledged as a difficulty in this *Dial*, may as well be made againſt the large *Azimuthal Quadrants* uſed by *Aſtronomers*, and their obſervations of *meridional Altitudes*, and *tranſits* through the *Meridian*; *Ricciolis Triangulum Filare* deſcribed *Almag. Nov. Lib.* 5. *Cap.* 15. *Probl.* 8. and all Enquiries after the *Declination* of the *Magnet* are to no purpoſe; for theſe wholly proceed on the diſcovery of an exact *meridian line*. And indeed there are ways ſufficiently accurate deſcribed by ſeveral for finding the true *meridian*. Amongſt others, *Hevelius* in the firſt Part of his *Machinia Cæleſtis*, *Chap.* 16. has many contrivances: And I ſhall preſently ſet down an Inſtrument and way of my own for doing it, inferior, I think, to none. But let us a little consider, how much a *meridian* line muſt be erronious, to make a true *Dial* apply'd to it to err a minute in time; and this in our *latitude* of *Dublin* will be 12' minutes of a *Quadrant* to make the *Dial* err a minute in time about noon; and for ſo much error in the *meridian* line the *Dial* ſhall err leſs than a minute in time about 5 and 6 a Clock, as is manifeſt to thoſe that underſtand calculating hour diſtances for an *Horizontal* plain. Now 'tis a very rude way indeed that will not take a *meridian* line more accurately than to half or quarter 12 minutes error.

But laſt of all, (clearly to take off this difficulty,) if it be allowed that there is any moſt accurate way of telling the time of day or night, as by the *Altitude* of the Sun or Stars taken by large and curious Inſtruments, and Calculating thereby; I ſay, by ſuch a way as this I will ſet my *Dial*, and then ſurely it will be granted to be in a true *Meridian.* And perhaps this very hint may ſhew as accurate a way as any in the World for finding a *meridian* line; for the 12 a Clock line of a large and true *Dial* that is Set by ſuch an accurate obſervation muſt needs lye in a true *meridian* line.

But I am mindful of my promiſe, *Viz.*

CHAP.

CHAP. VII.

For Finding a Meridian Line.

THis is perform'd by means of the Inſtrument repreſented *Fig.* 12. *ABC* is a *Triangle.* (That which I have made is of Wood, but a good Mathematical-Inſtrument-maker would make one much better of Braſs.) *AB* I call the *Perpendicular* ſide, *BC* the *Horizontal* ſide; in the end of the *Horizontal* ſide at *E* there is a ſcrew, and from the ſaid *Horizontal* ſide there ſtrikes out a ſhort arm *D*, in which alſo there is a ſcrew; this arm *D* keeps the Inſtrument ſteddy from tottering. By means of theſe two ſcrews at *D* and *E*, the ſide *AB* is brought to its exact perpendicularity; but eſpecially by means of the ſcrew *D*, the edge *x z* of the ſide *AB* is brought to ſtand exactly in the ſame *Vertical* plain with the edge *m n* of the ſide *BC*, and this by help of a Plumline. *F* is a plate of Braſs, having in it a center-hole in the line *m, n* continued. *G* is a round, ſlender, but ſtrong Braſs-pin ariſing perpendicularly from the face *m n.* 1,2,3,4,5, *&c.* are round Braſs-pins that riſe and ſtick out from the face *x z*, at what diſtances we pleaſe. This Inſtrument being placed truly on an exquiſite *Horizontal* plain,

ſo

ſo that its end *E* may ſomething over-ſtretch the plain, and turning ſteddily on a pin in the center-hole F, lay a *Ruler* adapted with *Teleſcopick Sights* over the pin *G*, and any of the other 1, 2, 3, *&c.* as is found moſt convenient and agreeable to the *Altitude* of the Sun or Stars you obſerve by, at convenient times both before and after Noon. 'Tis therefore requiſite that in the under-ſide of your *Teleſcopick Ruler* towards the end next the eye, there be fixt a pin, that reſting on the pin *G* may keep the *Ruler* from ſlipping down in this declining poſture. Let us then ſuppoſe that about 9 a Clock in the morning on the Summer *Solſtice*, the *Teleſcopick Ruler* reſting on the pin G, and the third pin in the perpendicular side takes the Suns *Altitude* exactly, then on the *Horizontal* plain draw a line along the face *m*, *n*. Again, let us ſuppoſe that the *Ruler* removed upwards to the fourth pin, and there reſting, takes the Suns *Altitude* the ſame morning about half an hour after 9; then by the face *m n* let us draw another line on the *Horizontal* plain, and ſo let us proceed to elevate the *Ruler* on other pins, to make obſervations at 10, at half an hour after 10 the ſame morning, ſtill drawing lines on the *Horizontal* plain at each obſervation.

Then again in the afternoon let us deſcend by the ſame ſteps or pins, by which we riſe in the morning, diligently obſerving when the Sun comes to the correſponding *Altitudes*, and drawing lines as before. Here we ſhall have three or four obſervations made in the morning, and as many in the afternoon. Then *biſecting* theſe *Angles* from the point F, if all their *biſections* are coincident in the ſame right line, we are ſure that line is a true *meridian* line.

What is here ſaid of the Sun, and of obſerving by it at the Summer *Solſtice*, may be accommodated to the taking a *meridian* line at any time of the year by ſome fixt Stars, that being removed about 2 or 3 hours from the *Meridian*, have *Altitude* convenient; though in chooſing of a great *Altitude* there is no great nicety; for if *Refraction* do interpoſe in the morning-obſervation, it interpoſes as much in the afternoon-obſervation; ſo that 'tis as if it did not interpoſe at all. And here we have a way of finding a *Meridian* line by the Stars at night, which is of no ſmall advantage, they being not ſubject to ſudden alteration of their Declination, and conſequently this method may be practiſed at all times of the year.

And indeed if we are careful to have all things exact, *viz.* an exact *Horizontal* plain, the face *x z* in an exact *Vertical* with the face *m n*, the *Teleſcopick Ruler* and its Sights exactly adjuſted by the methods in the foregoing 5*th* Chapt. and be very diligent and accurate in obſerving the true *Altitudes*, this method of finding a *meridian line* will appear inferior to none that has yet been propoſed.

Such a plain *Teleſcopick Ruler* as is expreſſed in the 11*th.* Figure, of a convenient length, is ſufficient in this practice.

CHAP. VIII.

The Manner of obſerving the Time, and exactly determining it by the Sun or Stars.

ALL things being rightly adjuſted, and the *Dial* placed in an exact level or *Horizontal* poſture, and by a true *meridian* line, look at the Sun through the *Teleſcopick* or *Stile-Ruler*, and bring the *Menſurator* upon the Suns center, then ſhall the *Horizontal Ruler* cut the hour, minute, and part of a minute moſt exactly. But for Setting, or finding the error of a Clock, the beſt way is to bring the *Horizontal Ruler* to ſome full Diviſion, as, to ſome compleat minute; and by rightly managing the *Stile-ſcrew* and *Nut*, and *Stile-Ruler*, obſerve when the center of the Sun and *Menſurator* come together, for that is the exact time to which you placed the *Horizontal Ruler*. And indeed through the *Teleſcopick Sights* we ſhall perceive the motion of the Sun ſo very quick, that we may determine its being on and off the *menſurator* to 2 beats of a ſecond *Pendulum.* So that if it be granted me that I can bring and ſettle the *Horizontal-Ruler* to a full diviſion exactly, and not to err in placing it thereat over 3, 5, or 7 ſeconds, I can determine the time of day or night to 3, 5, or 7 ſeconds. But if this great exactneſs will not be allow'd me, I ſay it is not on the account of any fault in the *Theory* of this contrivance, which I dare aſſert to be moſt accurate in it ſelf, but on the account of the workmanſhip or deficiency of ſome of its parts. And that ſtrikes not at the Inventer; let thoſe that uſe them, and adjuſt them, look to their truneſs in all particulars.

The way of uſing this *Dial* at the Stars by night is much the ſame, only for theſe there are requiſite the Tables, at the end of this Book, of the Sun and Stars temporary *Right Aſcenſions*. In looking at, or obſerving a Star through the *Teleſcopick Ruler*, the *Horizontal Ruler* cuts the ſaid Stars *horary* diſtance from the *Meridian*, but then the hours are to be counted by the ſmaller Figures on the in-ſide of the limb. Thus, ſuppoſe I obſerve a Star, and find the *Horizontal Ruler* cut the ten a Clock line to which the great Figure of *X* is affixt, the *horary* diſtance of that Star from the *Meridian* is 22 hours, that is, twenty two hours are elapſed ſince that Star was laſt in our *meridian*, though really the Star be but 2 hours to the Eaſt of our *meridian*. This premiſed, the great Rule for telling the time by the Stars is this; *To the Stars horary diſtance from the meridian, add the Stars temporary Right Aſcenſion, and from the Sum ſubſtract the Suns Right Aſcenſion, the remainder (rejecting 24 hours if need be) gives the hour, minute, &c. of the night.*

I ſhall declare this by an Example. *Anno* 1686. *April* the 5*th.* between 9 and 10 a Clock at night I deſire to know the exact time. I obſerve by *Spica Virginis*, and find (ſuppoſe) its horary diſtance from the *meridian* 22 *h.* 03′ 15″. The temporary *Right Aſcenſion* of that Star for that year is, 13 *h.* 08′. 46″, this added to the foreſaid *horary* diſtance, the ſum is 35 *h.* 12′. 01″. At the ſame time the Suns place is ♈. 26° 13′ 59″. Therefore its *Right Aſcenſion* in time by the following Tables, is 1 *h.* 37′. 17″. this ſubſtracted from the foreſaid ſum (and rejecting 24 hours) leaves 9 *h.* 34′ 44″. the exact time of night. The reaſon and demonſtration of this method depends on Aſtronomical Principles, which at preſent I muſt not undertake to illuſtrate, but are obvious enough to thoſe that are verſed in that Science, and will be very plain to thoſe that conſider the way of Calculating the hour of the night by the *Altitude* of a Star given, according to the moſt Learned and Ingenious *Pere Tacquets* Illuſtration thereof in his Aſtronomy, *Lib.* 5. *Cap.* 4. *Num.* 45.

And though there are other ways of ordering the foregoing *Data*, for getting the hour of the night, yet what I propoſe is as plain and eaſy as any, and leſs embarras to the mind.

But here I muſt not omit one particular, and that is, that by our preſent contrivance, the *Right Aſcenſion*, or place in the *Æquator* of any Star, is moſt eaſily and accurately obtained. How difficult and troubleſome 'tis to obtain the *Right Aſcenſion* of Stars, is known to Aſtronomers, and will appear to thoſe that conſult the forementioned *Tacquet Aſtronom. Lib.* 5. *Cap.* 1. *num.* 4, 5. but by this Inſtrument, and a truly rectify'd *Pendulum* Clock, the buſineſs is eaſily perform'd: For, from the ſum of the Suns *Right Aſcenſion*, and hour of the night (known by the Clock) ſubſtract the Stars hour on the *Dial*, the remainder is the Stars *Right Aſcenſion* in time, which converted into degrees and minutes, ſhews the *Æquatorian* diſtance of the Star from the firſt point of ♈, or its *Right Aſcenſion.*

CHAP. IX.

Of the Tables of the Suns and Stars Temporary Right Aſcenſions.

THe Table of the Stars *Right Aſcenſions* in time is plain enough of it ſelf. 'Tis computed to the year 1686, and will ſerve for ten years to come without the error of half a minute.

nute. 'Tis according to *Riccioli*'s Catalogue of fixt Stars in his *Aſtronomia Reformata*. It conſiſts of 5 Columns, the firſt contains the *Magnitudes*, the ſecond ſhews the *Greek Letters* by which each *Star* is marked in *Bayers Uranometria* Printed at *Ausburg*, 1603. The third has the numbers by which each *Star* is noted in *Ticho*'s Catalogue, which is followed by moſt Authors, but is to be found particularly in *Tichonis Brahe Aſtronomiæ Inſtauratæ Progymnaſmata*, *pag.* 258. and at the end of the *Rudolphine Tables* publiſhed by *Kepler*. The fourth Column contains the *Stars* names, as they are in *Bayer*'s *Uranometria*; and alſo after each name we expreſs the common name in *Engliſh*, and as they are to be found on our common Globes. And here we muſt not wonder to find that called *Right* or *Left* in the *Latin* names of *Bayer*, that is called *Left* or *Right* in the *Engliſh* common names; as for inſtance, *Herculis Humerus Dexter*, is in *Engliſh*, the *left ſhoulder of Hercules*. For the reaſon of this will appear plain to thoſe that conſider the Conſtellations of *Bayer*, and the common Conſtellations on our *Globes*. And I thought it not amiſs to take all this care, and expreſs all theſe marks for the ſake of thoſe that are not ſo well verſed in the appearance of the Firmament, that they may the readier find out, and not ſo eaſily miſtake any of the forementioned *Stars*. The fifth and laſt Column expreſſes the *Right Aſcenſion* in time of each *Star* to the preſent year *1686.*

The Tables of the Suns *Right Aſcenſion* in time require the Suns place to be had from ſome good Tables or *Ephemerides.* They conſiſt of four Columns, the firſt contains every degree and 10 minutes of the Suns place, the ſecond contains the hours appropriated to the ſigns between the *Vernal* and *Autumnal Equinox*, the third ſhews the hours appropriated to the ſigns between the *Autumnal* and *Vernal Equinox*; and the fourth and laſt ſhews the parts of an hour, that is, minutes and ſeconds, that are common to the oppoſite ſigns. By the ſide of each diviſion are expreſſed the differences between every 10 minutes of the Suns place, for more ready making proportion. For Example, ſuppoſe the Suns place were ♈. 25°. 10′ I find its *Right Aſcenſion* 1 *h.* 33′ 15″. But if his place were ♎ 25°. 10′. the *Right Aſcenſion* would be 13 *h.* 33′. 15″. Where we ſee 33′. 15″. common to both places. But ſuppoſe I find by a good *Ephemeris* the Suns place about my required time to be ♈ 25°. 15′ then by making proportion I find by the Tables the *Right Aſcenſion* to be 1 *h.* 33′. 34″. For I ſay if 10′ (the common difference of the minutes) give 38″, what ſhall 5′ (the difference between 10′ and 15′) give, and it will be 19″, which added to 1 *h.* 33′. 15″. makes 1 *h.* 33′ 34″.

I know the common way for giving the Suns

Right Aſcenſion is by making a Table of the days of the month, and giving the Suns *Right Aſcenſion* to the days: But this way, if it be *general*, and not appropriated to a certain year, is not accurate to a minute or two: and if it be *adapted* to a *certain* year, 'tis not *general*, and will not ſerve another time. Whereas our Tables of the Suns *Right Aſcenſion* are *general*, moſt *accurate* to a ſecond, and *perpetual*.

CHAP. X.

Concerning the Aſtronomical Equation of Time, and the Tables thereof.

BEing now upon the buſineſs of Time, and the accurate obſervation thereof, ſo as thereby to regulate curious Time-keepers; it will not be improper to our ſubject to ſpeak ſomething of the *Inequality* of natural Days; a matter that has exerciſed the thoughts of all Aſtronomers in all ages: And though all have allowed that there really is ſuch an *Inequality*, yet they have much diſagreed in aſſigning its quantity, or demonſtrating the reaſon and affections thereof; till at laſt our moſt Learned and Ingenious *Engliſh* Aſtronomer, and my Honoured Friend Mr. *John Flamſteed Math. Regius*, has determined the Controverſy, and by moſt evident demonſtrations has put the matter beyond further diſpute, clearly evincing both the Reaſons, Affections, and Quantity of this *Inequality*. His *Diſſertation* concerning this is annex'd and publiſh'd at the end of the *Opera Poſthuma Jeremiæ Horroxcii, Lond.* 1673. 4to. From which (with my eſteemed Friend's leave) I ſhall preſent the Reader with the following Schemes and Demonſtrations.

On account of the Suns *Excentricity* from the center of the Earths *Annual Orbit*, the *Diurnal* motion of the Earth is ſometimes faſter, and ſometimes ſlower than the *mean* motion, and conſequently the *apparent* Day is ſometimes longer, and ſometimes ſhorter than the *mean* Day. Which *Inequality*, and the Quantity of the difference of the *equal* or *mean* Day from the *apparent*, is thus demonſtrated from the 13 Figure, according to the *Copernican Syſtem*.

Let *ABPN* be the great *Orbit* in which the Earth is yearly carried about the *Sun*, the center hereof is *C*, *A* the *Aphelion*, or the Earths place at Noon on that day that it is in its *Aphelion*, ſuppoſe the 18*th*. of *June*. *B* the Earths place at Noon the day following. *AL* an aſſigned *Meridian* of the Earth. The arch *AB*, or the angle *ACB*, the mean motion of the Earth from the Noon of a given day to the Noon of the day following. *L* a point in the given *Meridian* turn'd to the *Sun*; which point, whilſt the Earth is carried in its *Orbit* from *A* to *B*, is rould by the *diurnal circumvolution* of the Earth from *L* through *O* in the firſt place *A* to *d* in the ſecond place *B*; to which place, when the ſaid point arrives, 'tis manifeſt that the Earth has performed a compleat revolution about its own *Axis*; becauſe the *meridian B d*, in this its ſecond poſture at *B*, is made parallel to *A L* its yeſterdays poſture at *A*. But it is not yet apparent Noon, till the ſame point of the Earth by its revolution be brought to *e*, where 'tis turn'd directly oppoſite to the *Sun*, who governs the Civil Days. And that this time is not the ſame with the *Cæleſtial* or *equal* Noon, will be proved, not only becauſe the Earth has not yet performed its *mean* motion above its revolution, (tho this were a ſufficient argument) but alſo becauſe the *diurnal* motions about the *Sun*, and conſequently the returns of any certain *meridian* to him, are very *unequal*; neither can they poſſibly be *equal* in reſpect of any point about which the Earth is not carried *equally*, as is ſufficiently manifeſt from the inſpection of the *Scheme* only. Wherefore the mean Noon and equal Time reſpects the point of the mean motion (*that is the center of the Orbit C*) and in our preſent inſtance is then when the *meridian* carried from *e* arrives at *f*, where 'tis directly oppoſite to the center of the *Orbit C*. And when it has gained this poſture, the Earth has performed its mean motion above a revolution requiſite to compleat a mean day. For the arch *d f* or the angle *d B f* is equal to the angle *A C B* the mean *diurnal* motion of the Earth. Alſo the arch *d e*, which the Earth, or any *meridian* therein, muſt paſs more than a revolution before it be apparent Noon, is equal to the angle *A S B* the apparent motion of the Earth at the Sun. From whence 'tis evident, that the arch *e f*, which the circumference of the rouling Earth performs between the apparent and mean Noon, and which ſhews the difference between the apparent and mean Day, is equal to the angle *S B C*, which is the *Equation* of the *Orbit*. Wherefore the *Proſthaphæreſes* of the *Orbit* reſolved into parts of time, ſhall be the *Æquations* of time; which *Æquations*, throughout this *ſemicircle* of *Anomoly* are negative, or to be ſubſtracted from the *apparent* time, for herein the *mean* Noon ſucceeds the *apparent*.

In like manner, if we take the oppoſite parts of the Scheme, and conſider the Earth in its *Perihelion*. The point *g*, or the *meridian n g*, being made parallel to its yeſterdays poſture, 'tis plain that the Earth has performed one compleat revolution. This point being carried to *b*, where 'tis oppoſite to the center of the *Orbit*, 'tis now mean Noon; for the arch *g b*, or the angle *g N b* equal to the mean *diurnal* motion of the Earth, is paſſed over. But it is not *yet* apparent Noon, till the

Earth by its rouling brings the ſame *meridian* to *k*, where 'tis directly oppoſite to the Sun. From whence 'tis manifeſt that the *apparent* Day exceeds the *mean* by ſo much time as is requiſite for the earth to paſs the arch *h k*, which arch is equal to the angle *C N S* the *Profthapheresis* of the *Orbit*: wherefore reſolving this into time, we have the *Æquation* of time, which throughout this *ſemicircle* of *Anomoly* is *affirmative*, or to be added to the apparent time, becauſe herein the *mean* Noon precedes the *apparent*.

'Tis manifeſt from what foregoes, that if the Sun were in the center of the great *Orbit*, and the Earths *Axis* were not *inclined* to its path or way, there would be no *Inequality* of time, but the mean Day and apparent would be equal. Moreover, if there were no *excentricity* of the Sun from the center of the *Orbit*, but there were the uſual inclination of the Earths *Axis* to the *Orbit*, tho there would no *Inequality* of time ariſe ſuch as is ſhewn in the foregoing demonſtration; yet there would ariſe another *Inequality* from the ſaid inclination of the Earths *Axis*, or as the *Ptolomaicks* would expreſs it, from the inclination of the *Ecliptick* to the *Æquator*; the quantity and affections of which *Inequality* is thus ſhewn by the *Analemma.*

In *Fig.* 14. *P C F* is a Quadrant of the *Solſtitial Colure*, *P* the *Pole*, *A F* a *Radius* of the *Æquator*, *C A* a

Radius of the *Ecliptick*, A the *Equinoctial* point, or the place of the Sun in the beginning of ♈ at noon on ſome certain day, ⊙ the Suns place at noon the day following; through which place ſtriking the arch $P \odot B$ *perpendicular* to the *Æquator*, $A \odot$ will expreſs the *diurnal* motion of the Sun, and $A B$ its *Right aſcenſion*, or the arch of the *Æquator* that *Culminates* with the Sun. Which arch, ſeeing 'tis one of the ſides of a Right-angled *Triangle* $A \odot B$, cannot be equal to the *Hypotenuſe*, that is, to the Suns motion $A \odot$. Wherefore ſeeing the revolutions of the *Æquator*, and of its *equal* or like parts, are *equable*, and performed in *equal* times, but the Sun in paſſing equal parts of the *Ecliptick* applies to the *meridian* with *unequal* parts of the *Æquator*; it neceſſarily follows that the *ſolar* days are *unequal*. And that the difference between the Suns true place and its *Right aſcenſion* being converted into time, is the true *Æquation* of time ariſing from this cauſe. Which *Æquation*, in the firſt and third *Quadrants* of the *Zodiack* is to be ſubſtracted from the *apparent* time, for in them the *longitude* of the Sun from the next *Equinoctial* point paſſes the *meridian* ſooner than a like arch projected in the *Æquator*. But in the 2*d* and 4*th Quadrants* of the *Zodiack* this *Æquation* is to be added to the *apparent* time to get the *mean*; for in theſe the *longitude* of theSun from the *Æquinox* paſſes the *meridian* later than the like Arch projected in the

Æquator. For example, let the *longitude* of the Sun from the firſt point of ♈ be ⊙ *A*. 0°. 59′. 08″. its *Right aſcenſion*, or the arch of the *Æquator culminating* therewith *AB* will be 0°. 54′. 13″. their difference 4′. 55″. being converted into time is 00^{h} 00′. 19″. 40‴, and by ſo much is the *apparent* day ſhorter than the *mean*. This therefore is the *Æquation* of time ariſing from this cauſe, and is negative, or to be ſubſtracted from the *apparent* time, to obtain the *mean* time; for the *longitude* of the Sun arrives at the *meridian* ſooner than a like arch projected in the *Æquator*.

Here are therefore demonſtrated two ſorts of *Æquations* of time ariſing from two different cauſes, if they are both to be added, or both to be ſubſtracted, their ſum is to be added or ſubſtracted; but if one be to be added, and t'other ſubſtracted, their difference according to the nature of the greateſt is to be added or ſubſtracted to or from the *apparent* time to get the *mean*.

And thus far I have preſumed to borrow from my Learned and Ingenious Friend's Diſcourſe; which is ſufficient, I think, to put this matter out of all diſpute.

After clearing the *Theory* of this Doctrine, I come next to apply it to practice in regulating curious Time-keepers, which indeed are very often abuſed for want of the due conſideration and right application of this *Æquation* of time. For at ſome time of the year it happens that if our *Watches* or *Oſcillating Pendulums* do not differ above a quarter of an hour from the time ſhew'd by the Sun or Stars, they are falſe, and need a correction. And the reaſon of this is plain, for if a *Pendulum-Watch* goes true, it goes *equal*, that is, one 24 hours at any time of the year, is as long as another 24 hours at any other time of the year, and this perpetually and conſtantly; that is, all Watches that go true, meaſure the *equal* or *mean* time, and conſequently ought to differ from the *apparent* time ſhewn by a *Sun-dial* or other Inſtrument, as much as is the *Æquation* of time in exceſs or defect; but the *Æquation* of time is ſometimes above a quarter of an hour, therefore ſo much ought a good-going *Pendulum-watch* to differ ſometimes from the Sun, if it be rightly adjuſted. But this will be more evident by explaining the Tables. Theſe are calculated by the foregoing *Theory*, and will ſerve very well for theſe 20 years to come; though it muſt be confeſt, that to have them moſt accurate, theſe Tables ought to be Calculated for every year, as is manifeſt to thoſe that conſider the foregoing *Theory*. Yet I ſay, theſe will ſerve very well for 20 years to come, without any conſiderable error. Some few ſeconds error there may be, and he that deſires them more exact, may be at the pains of Calculating them himſelf; the method whereof he may find laid down in the forementioned Treatiſe at the end of *Horrox*'s Works; or in Mr. *Flamſteed's Doctrine of the Sphere* publiſh'd in *Sir J. Moore's Syſtem of Mathematicks.* We ſee there are only four days in the year on which the *æquations* of days ceaſe, that is, the *apparent* and *mean* time are then the ſame, *viz.* on the 4*th.* of *April*, *June* the 6*th.* *Aug.* the 21*ſt.* and *Decemb.* 13. If on any of theſe days we Set a well-regulated *Pendulum-watch* to the *apparent* time ſhewn by the Sun or Stars, on any day afterwards, it ought to differ from the *apparent* time ſhewn by the Sun ſo much as is the *Æquation* of time in the Table. If the *Æquation* is to be ſubſtracted, the *Pendulum* ought to be ſo much ſlower than (or behind) the Sun; if the *Æquation* is to be added, the *Pendulum* ought to be ſo much faſter than (or before) the Sun. For upon any day of the year obſerving the time exactly by Sun or Stars, that time is the *apparent* time, and to gain the *mean* time which ought to be ſhewn by the Clock, we are to add too or to ſubſtract from the ſaid *apparent* time, the *Æquation* anſwering to the day of our obſervation. Suppoſe for inſtance, on the 4*th* of *April* I obſerve the time by the Sun, here becauſe the *Æquation* ceaſes, the *apparent* and *mean* time are the ſame, and therefore I am to ſet my Clock to the exact and full time, as the Sun or Stars ſhew it; but if the *Pendulum* go exactly true, and it move to the 4*th* of *May*, I ſhall find it 4′. 17″ behind the Sun, for ſo much is the *æquation* on the 4*th* of *May* to be ſubſtracted from the *apparent* time of the Sun to gain the *mean* time of the Clock; that is, when the *Sun* ſhews it to be 9 a Clock in the morning, the Clock ought to be but 8 *h*. 55′. 43″. And if I find the *Pendulum* more or leſs behind the *Sun*, it has not gone truly as it ought, but the *Pendulum* or *ſwagg* is to be lengthned or ſhortned as is requiſite to make it gain or loſe the difference betwixt the time ſhewn by the Clock, and 8 *h*. 55′. 43″. in 30 days elapſed between the 4*th* of *April*, and 4*th* of *May*; according to a Table, whoſe uſe I ſhall declare preſently. But if the Movement be exquiſitely true, if it go to the 6*th* of *June*, it will again ſhew the ſame time with the *Sun* or *Stars*, for then again the *Æquation* is nothing. And if it go onwards exactly to the 3*d* of *Auguſt*, it will be 4′. 18″. before the *Sun*; for at that time ſo much is the *æquation* to be added to the *apparent* time to make it the *mean*. 'Till again on the 24*th* of *October* the Watch ought to be 16′. 4″. behind the *Sun*, for ſo much is the *æquation* on that day to be ſubſtracted.

Wherefore if at any time we ſet our *Pendulum-Watch* in order to rectify it, and bring it exactly to meaſure the *mean* day, we are to add to or ſubſtract from the *apparent* time ſhewn by the *Sun* ſo much as is the *æquation* of days at the time we ſet it. For example, at noon, or juſt when the *Sun* is in the *Meridian* on the *9th* of *September*; that is, when the *apparent* time is exactly 12 a Clock, I ſet my Watch, the *æquation* is then 6'. 26''. *ſubtr*. Wherefore I ſet my Watch to 11 *h*. 53'. 34''. Which, if it go right, that is *equally* as it ought, on the *9th* of *October* will be 14'. 52''. behind the the *Sun*; if it be either more or leſs behind or before the *Sun*, it has gone falſe, and is to be rectified by lengthning or ſhortning the *Pendulum* as much as is requiſite to make it gain or loſe the difference between 14'. 52'' behind the *Sun* and its error whatever it is in 30 days time elapſed between the *9th* of *Septemb.* and *9th* of *Octob.* But if at any other time of the year we ſet our Watch when the *æquation* is to be added, we muſt put it ſo much before the Sun as is the *æquation.* But this is plain enough without further Illuſtration.

Of the certainty and exactneſs of this *æquation* of time, I have made a moſt convincing Experiment by an exquiſitely rectified *Pendulum-Clock*, which I bought from Mr. *Richard Jarrat* Watchmaker in *Lothbury*, *London*, whom I can therefore recommend for his honeſty and ability.

And becauſe I have ſpoken in this Chapter of lengthning or ſhortning of a *Pendulum*, ſo as to make it go ſlower or faſter ſo much in a certain time; for doing this more regularly, and not by gueſs, I have here added a Table adapted to a *Pendulum*

dulum that *Vibrates ſeconds*, which is ſuppoſed to be 39.2 inches long. Sir *Jonas Moore* in his *Mathematical Compendium, pag.* 113. gives us ſuch a Table as this, but whether by the fault of the Printer or Calculator 'tis very erronious, as any one may find that will be at the pains to examine it by the following Rules for Calculating theſe Tables. The Rule is, *the lengths of Pendulums are to each other reciprocally as the ſquares of their vibrations in the ſame time.* Thus, if a *Pendulum* 39.2 inches long *vibrate* 60 times in a minute, how oft will a *Pendulum* 9.8 (*viz.* quarter of 39.2) inches *vibrate* in a minute? by the foregoing Rule the proportion ſtands thus, 9.8 : 39.2 :: 3600 : 14400, whoſe ſquare Root is 120; therefore a *Pendulum* 9.8 will *vibrate* 120 times in a minute. So if it be required how oft a *Pendulum* 39.0 inches *vibrates* in a minute, the *Analogy* will be this, 39.0 : 39.2 :: 3600 : 3618. whoſe ſquare Root is 60.15, that is, a *Pendulum* 39.0 inches long *vibrates* in a minute 60 times, and 15 hundreds of a *vibration* more than 60 times. So that multiplying 15 hundreds of a *vibration* by 1440 the number of minutes in 24 hours, we get the number of *vibrations* which a *Pendulum* 39.0 inches long *vibrates* in a day more than one of 39.2; and ſeeing each *vibration* of the *Pendulum* in a Clock adapted for it, ſets the hand forward a ſecond, by knowing the number of *vibrations* which a *Pendulum* 39.0 inches long performs in a day more than a *Pendulum* 39.2 inches long, we may know the number of ſeconds which it will advance the *Index* of the Clock forward more than one 39.2 inches long. And by theſe Rules are the following Tables Calculated.

1	2	3	4
38.7	60''.3863	9'. 16''. 16'''	1'. 52'' 06'''
38.8	60.3084	7 . 24 . 10	1 . 51 . 40
38.9	60.2309	5 . 32 . 30	1 . 51 . 20
39.0	60.1536	3 . 41 . 10	1 . 50 . 40
39.1	60.0766	1 . 50 . 20	1 . 50 . 20
39.2	60.0000	0 . 00 . 00	
39.3	59.9236	1 . 50 . 00	1 . 50 . 00
39.4	59.8475	3 . 39 . 36	1 . 49 . 36
39.5	59.7717	5 . 28 . 45	1 . 49 . 09
39.6	59.6962	7 . 17 . 30	1 . 48 . 45
39.7	59.6210	9 . 05 . 45	1 . 48 . 15

The firſt Column has in the middle the length of the *Pendulum* 39.2; upwards it diminiſheth one tenth, and downwards it increaſeth one tenth. The ſecond Column is the *vibrations* and parts of a *Vibration* performed in a minute by the lengths in the firſt. The third Column is the minutes and ſeconds that theſe lengthnings and ſhortnings of the *Pendulum* will cauſe in a day, and are gotten by multiplying 1440′ the minutes in a day by the *Decimals* above or under 60″. The 4*th* and laſt Column are the differences of the 3*d*. The like Table may be made to any length of a *Pendulum*, reſpect being had to the foregoing Rule.

I ſhall conclude all relating to my *Dial* with the Calculation of hours and minutes for an *Horizontal Dial* for the *latitude* of *Dublin* 53°. 20′. Which I believe will not be unacceptable to thoſe that deſign curious *Dials* for that place.

The Tables follow amongſt the others.

CHAP. XI.

Of the Tables of the Circumpolar Stars, their Calculation and Uſes.

I Shall here, as a concluſion to this Work, add ſomething concerning very uſeful Tables for ſhewing the time of night very accurately, and other operations by the *Circumpolars*, or Stars that never ſet in our *latitude* of *Dublin*. Such Tables as theſe we have mentioned in Sir *J. Moore*'s *Mathematical Compendium p.* 118, 119. but they are for the *latitude* of *London*; neither does he give us all their uſes, or the method of Calculating them for other places. I ſhall do both in this place, and firſt for their uſe.

In any *Northern* Window, or other convenient place, hang up a good weighty Plummet by a fine and even ſilk or ſilver-wire, then placing your eye at ſome diſtance behind this thred, that is, to the *South* thereof, obſerve when any of the Stars mentioned in the Table are cut by this thred at the ſame time with the *Pole-Star*. *From the Stars Right aſcenſion in the Table (adding 24 hours if need be) ſubſtract the Suns right aſcenſion, the remainder gives the hour, minute, and ſecond of the night.* The Tables conſiſt of 6 Colums, the firſt ſhews the *Magnitudes*; the ſecond contains the *Stars* names, as they are deſcribed on our common *Engliſh Globes*; the third ſhews the *Right aſcenſion* of the *Mid-heaven* in time, when any of theſe Stars come in the ſame *Vertical* with the *Pole-Star*, by which (working according to the foregoing Rule) we find the hour of the night; the fourth Column gives the *difference in time* between the coming of any of theſe Stars under the *Pole-ſtar*, and their coming under the *Pole* it ſelf. Some of theſe *Stars* paſs the *Meridian*, or come under the *Pole* before they come under the *Pole-Star*, ſuch as are all the *Stars* whoſe *Right aſcenſions* are above 9°. 14'. 10", and under 189°. 14'. 10". And of theſe we ſay nothing in this place, only they are all marked in the Table with *E*, as having their *Azimuth* when under the *Pole-ſtar Eaſtward.* But of theſe Stars in this Catalogue which paſs the *Meridian*, or come under the *Pole* after they have left the *Vertical* of the *Pole-ſtar*, we make this following uſe. All theſe are marked in the ſixth Column with *W*, as having a *Weſtern Azimuth* when they are under the *Pole-ſtar*. Wherefore placing a ſecond *line* and *plummet* behind, or to the *South* of the former, then obſerve by the firſt when any of theſe Stars come under the *Pole-ſtar*, and by a *Pendulum* from that inſtant count the time in this fourth Column, and placing your eye now behind both the lines, juſt at the end of your count by gently moving this laſt thred, make them both cut the *Star* you count for, then are theſe two lines exactly in the *meridian*; and is a curious way for finding a *Meridian line*. The fifth and ſixth Columns ſerve for the ſame uſe; for when any of theſe *Stars* are under the *Pole-ſtar*, making your two lines cut both *Pole-ſtar* and t'other, theſe two lines hang ſo far out of the *Meridian line*, as is the *Azimuth* expreſſed in the Table, which *Azimuth* is ſhewn to be *Eaſt* or *Weſt* by the *6th* Column. Wherefore this angle being ſet off from the found line, ſhews the true *Meridian*. And we may obſerve, that there are three *ſtars* expreſſed in the Table, which being under the *pole-ſtar* are inſenſibly nigh the *Meridian*, theſe are *Caſſiopeia's Hipp*, *Cor Caroli*, and *Aliot* or the *Great Bears Rump.* Wherefore, whenever we have any of theſe under the *pole-ſtar*, we may by it find a *Meridian line* without any ſenſible error. Another uſe that we may make of this Table, is for the true adjuſting of *Hour-glaſſes* and other *Time-keepers*, as *Pendulum-Watches*, &c. for trying their going, and bringing them to their right meaſure. Thus we ſhall find it juſt four hours (wanting one ſecond) between the coming of *Cor Caroli*, and the 24*th Star* of *Draco* (in *Tich. Catal.*) under the *Pole-ſtar*; for when *Cor Caroli* is under the *pole-ſtar*, the *Right Aſcenſion* of the *Mid-heaven* in time is 00*h*. 36′. 44″. And when the 24*th* of *Draco* is under the *pole-ſtar*, the *mid-heavens temporary Right Aſcenſion* is 4*h*. 36′. 43″. their difference is 3*h*. 59′. 59″. which wants only one ſecond of four hours. Note that this 24*th* of *Draco* is marked in *Bayer* by *i*.

I come now to ſhew the method of Calculating this Table, for which ſee the 15 and 16 Figures. Wherein $axbp$ is the circle deſcribed by the *pole-ſtar* x round the *pole* p, z the *Zenith*, zn the *meridian*, whoſe *North* part is pn, s is any other *Circumpolar ſtars*, zxs a *Vertical circle*, hn the *Horizon*, $æq$ the *Æquator*, po the *Axis Mundi*. There are here given (or at leaſt may be known from the Tables) px the Complement of the *pole-ſtars Declination*, ps the Complement of the other *ſtars Declination*, xps the difference of the *Right Aſcenſions* of the *pole-ſtar*, and other *ſtar*, alſo zp the Complement of the *Poles Elevation*. Wherefore, in the *Triangle* spx, having sp, px, and the angle spx, we may find the angle sxp; and having that, we have the angle pxz, for this is the Complement of sxp to 180 degrees. Then in the *Triangle* zpx, we have zp, px, and the angle pxz, to find the angle pzx, which is the *Azimuth* that theſe two *Stars* have, when they come in the ſame *Vertical*, and makes the fifth Column in our Table. And from the ſame *Data*, we may find the angle zpx. Therefore in the *Triangle* zps, we have found the angle zps, for zps is equal to the ſum of zpx and spx. Now the difference between zps and 180 degrees is equal to the difference in time between the Star s coming under the *Pole-ſtar* and coming, under the *Pole*, or its being in the *Meridian*, and conſequently its having its own *Right Aſcenſion*, or its Complement; and this makes the fourth Column in our Table. Now this difference in time between the *Pole* and *Pole-ſtar* being added to or ſubſtracted from the true *Right Aſcenſion* of the Star s in time, gives the *Right Aſcenſion* in time of the Star s (or of the *mid-heaven*) when 'tis under the *Pole-ſtar*; and this makes our third Column in the Table. The Rule to know when this difference in time between the *Pole* and *Pole-ſtar* is to be added, and when to be ſubſtracted, will be evident by obſerving, that all ſuch *Stars* whoſe *Right*

Aſcenſions are above the *Right Aſcenſion* of the *Pole-ſtar* (for the year, as for 1680) 9°. 14′. 10″, and under 189°. 14′. 10″. paſs the *meridian* before they come under the *Pole-ſtar*; all the other *ſemicircle*, contrarily; for if the Star paſs the *meridian* before it comes under the *Pole-ſtar*, this difference in time between the *Pole* and *Pole-ſtar* is to be added to the *Right Aſcenſion* of the *Star*; if the contrary, 'tis to be ſubſtracted.

FINIS.

TABLES

OF THE

Suns Right Aſcenſion in Time

TO EVERY

Ten Minutes of the ECLIPTICK.

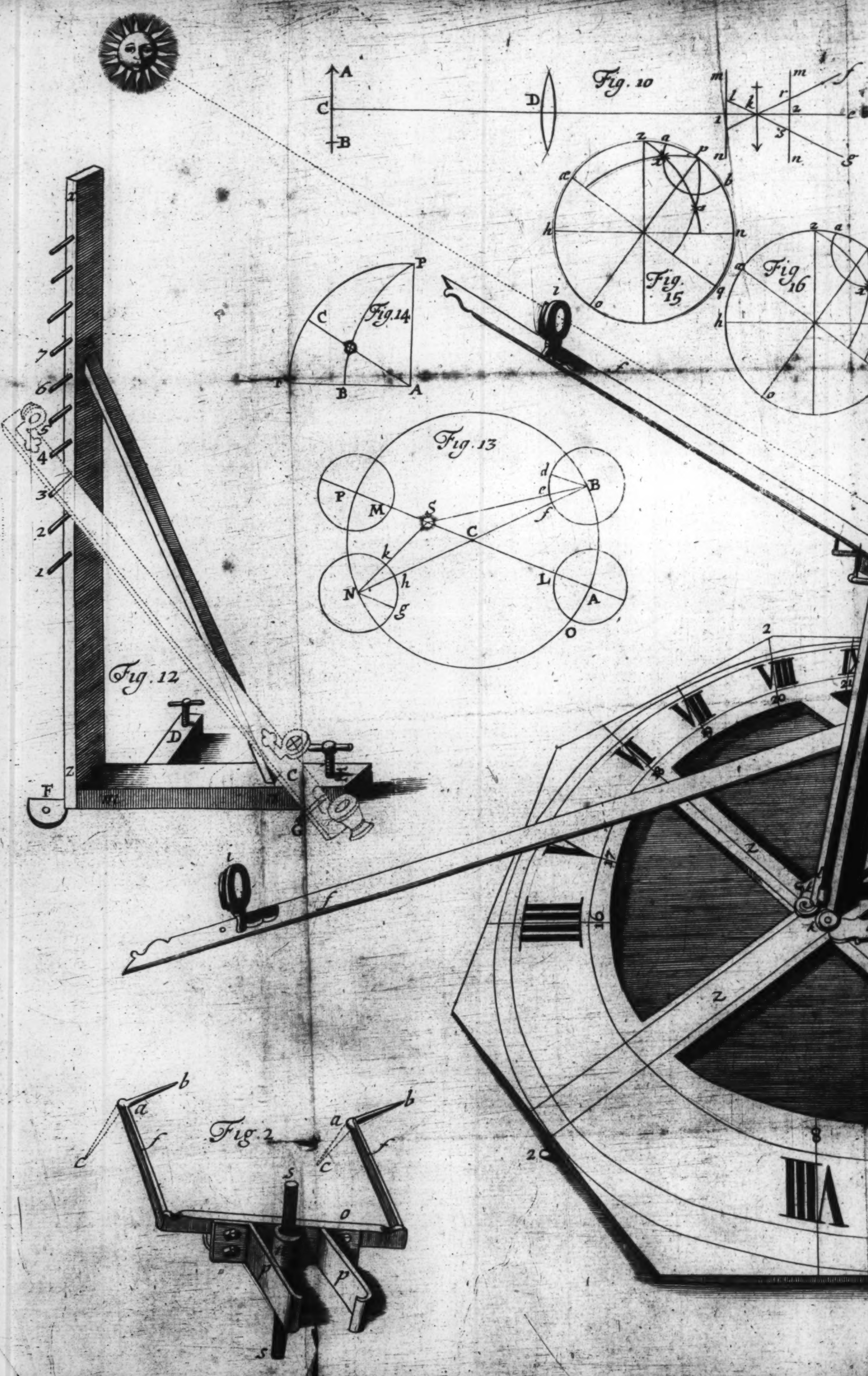
Fig. 10
A
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D
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k
r
f
1
2
e
3
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Fig. 15
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x
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n
o
q
Fig. 16
Fig. 14
P
C
B
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Fig. 13
d
e
B
P
M
S
C
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N
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L
A
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Fig. 12
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2
1
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Z
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C
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i
f
VIII
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Fig. 2
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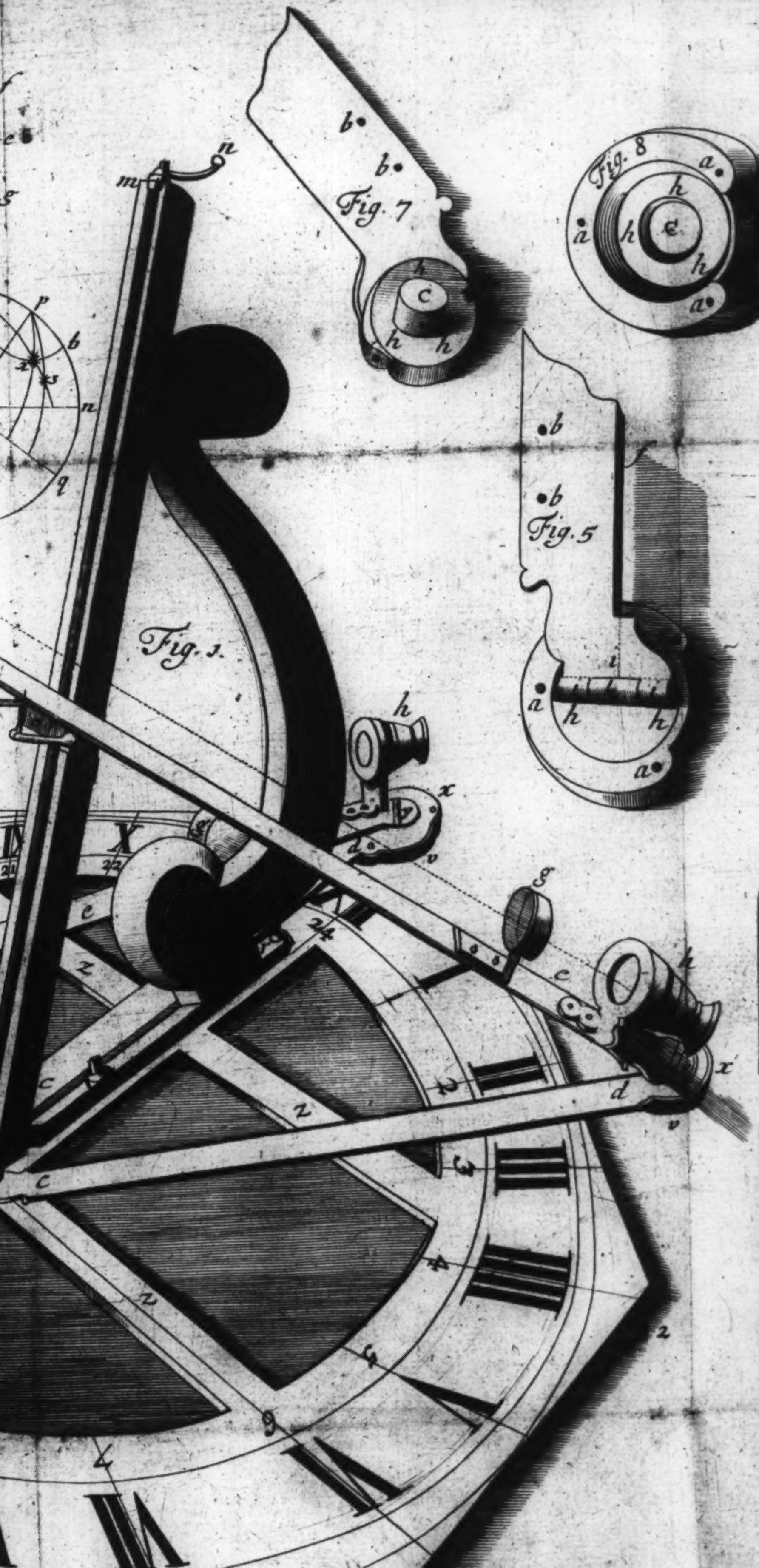

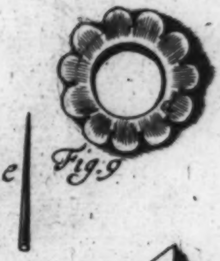

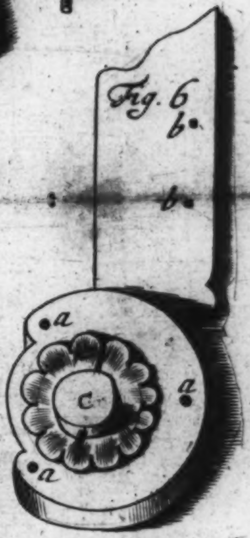

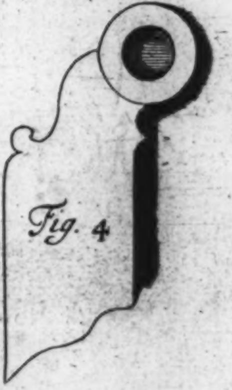

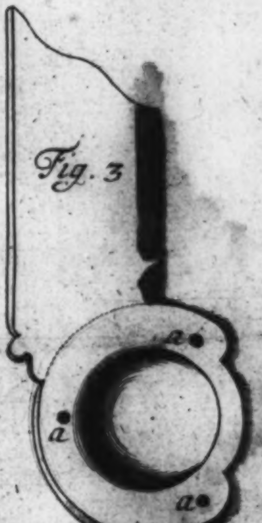

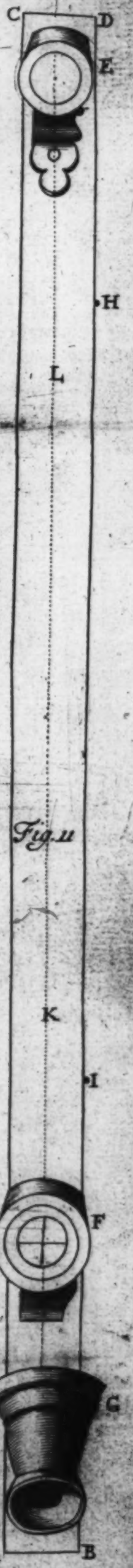

To be inſerted at the End of the book before the Tables.

D. m.	♈ H	♒ H	Com. Pra. ′ ″	X
0. 0	0	12	0. 0	
10	0	12	0.37	″
20	0	12	1.13	37
30	0	12	1.50	
40	0	12	2.27	
50	0	12	3. 3	
1. 0	0	12	3.40	
10	0	12	4.17	″
20	0	12	4.53	37
30	0	12	5.30	
40	0	12	6. 7	
50	0	12	6.43	
2. 0	0	12	7.20	
10	0	12	7.57	″
20	0	12	8.33	37
30	0	12	9.10	
40	0	12	9.46	
50	0	12	10.23	
3. 0	0	12	11. 0	
10	0	12	11.37	″
20	0	12	12.13	37
30	0	12	12.50	
40	0	12	13.26	
50	0	12	14. 3	
4. 0	0	12	14.40	
10	0	12	15.17	″
20	0	12	15.53	37
30	0	12	16.30	
40	0	12	17. 6	
50	0	12	17.43	

D. m.	♈ H	♒ H	Com. Pra. ′ ″	X
5. 0	0	12	18.20	
10	0	12	18.57	″
20	0	12	19.33	37
30	0	12	20.10	
40	0	12	20.46	
50	0	12	21.23	
6. 0	0	12	22. 0	
10	0	12	22.37	″
20	0	12	23.13	37
30	0	12	23.50	
40	0	12	24.26	
50	0	12	25. 3	
7. 0	0	12	25.41	
10	0	12	26.18	″
20	0	12	26.55	37
30	0	12	27.32	
40	0	12	28. 9	
50	0	12	28.46	
8. 0	0	12	29.23	
10	0	12	30. 0	″
20	0	12	30.36	37
30	0	12	31.13	
40	0	12	31.50	
50	0	12	32.26	
9. 0	0	12	33. 3	
10	0	12	33.40	″
20	0	12	34.16	37
30	0	12	34.53	
40	0	12	35.30	
50	0	12	36. 7	

D. m.	♈ H	♎ H	Com. Pts. ' ''	X
10. 0	0	12	36 44	
10	0	12	37.21	''
20	0	12	37 58	37
30	0	12	38.35	
40	0	12	39.12	
50	0	12	39 49	
11. 0	0	12	40.26	
10	0	12	41. 3	''
20	0	12	41.40	37
30	0	12	42.17	
40	0	12	42.54	
50	0	12	43 31	
12. 0	0	12	44. 7	
10	0	12	44 44	''
20	0	12	45.21	37
30	0	12	45.58	
40	0	12	46 35	
50	0	12	47.12	
13. 0	0	12	47.49	
10	0	12	48.26	''
20	0	12	49 03	37
30	0	12	49 40	
40	0	12	50.17	
50	0	12	50.54	
14. 0	0	12	51.31	
10	0	12	52. 8	''
20	0	12	52.45	37
30	0	12	53.22	
40	0	12	53.59	
50	0	12	54.36	

D. m.	♈ H	♎ H	Com. Pts. ' ''	X
15. 0	0	12	55.13	
10	0	12	55.50	''
20	0	12	56.27	37
30	0	12	57 4	
40	0	12	57.41	
50	0	12	58.19	
16. 0	0	12	58.56	
10	0	12	59.33	''
20	1	13	00.10	37
30	1	13	00.47	
40	1	13	1 24	
50	1	13	2. 2	
17 0	1	13	2.39	
10	1	13	3.16	''
20	1	13	3.53	37
30	1	13	4 30	
40	1	13	5. 7	
50	1	13	5.45	
18. 0	1	13	6.22	
10	1	13	6 59	''
20	1	13	7 37	37
30	1	13	8.14	
40	1	13	8 52	
50	1	13	9 29	
19. 0	1	13	10. 6	
10	1	13	10.43	''
20	1	13	11.21	37
30	1	13	11.58	
40	1	13	12.36	
50	1	13	13.13	

D. m.	♈ H	≏ H	Com. Pts. ′ ″	
20. 0	1	13	13.50	
10	1	13	14.27	
20	1	13	15. 5	″ 38
30	1	13	15.42	
40	1	13	16.20	
50	1	13	16.57	
21. 0	1	13	17.34	
10	1	13	18.12	
20	1	13	18.50	″ 38
30	1	13	19.27	
40	1	13	20. 5	
50	1	13	20.43	
22. 0	1	13	21.19	
10	1	13	21.57	
20	1	13	22.35	″ 39
30	1	13	23.12	
40	1	13	23.50	
50	1	13	24.28	
23. 0	1	13	25. 5	
10	1	13	25.42	
20	1	13	26.20	″ 39
30	1	13	26.57	
50	1	13	27.35	
50	1	13	28.13	
24. 0	1	13	28.50	
10	1	13	29.28	
20	1	13	30. 6	″ 39
30	1	13	30.44	
40	1	13	31.22	
50	1	13	32. 0	

D. m.	♈ H	≏ H	Com. Pts. ′ ″	
25. 0	1	13	32.37	
10	1	13	33.15	
20	1	13	33.53	″ 38
30	1	13	34.31	
40	1	13	35. 9	
50	1	13	35.46	
26. 0	1	13	36.24	
10	1	13	37. 2	
20	1	13	37.40	″ 38
30	1	13	38.18	
40	1	13	38.56	
50	1	13	39.33	
27. 0	1	13	40.11	
10	1	13	40.49	
20	1	13	41.27	″ 38
30	1	13	42. 5	
40	1	13	42.43	
50	1	13	43.21	
28. 0	1	13	43.59	
10	1	13	44.37	
20	1	13	45.15	″ 38
30	1	13	45.53	
40	1	13	46.31	
50	1	13	47. 9	
29. 0	1	13	47.47	
10	1	13	48.25	
20	1	13	49.03	″ 39
30	1	13	50.41	
40	1	13	51.19	
50	1	13	51.58	

D. m.	♉ H	♍ H	Com. Pts. ′ ″	
0. 0	1	13	51.36	
10	1	13	52.14	″
20	1	13	52.52	38
30	1	13	53.30	
40	1	13	54. 8	
50	1	13	54.47	
1. 0	1	13	55.25	
10	1	13	56. 4	″
20	1	13	56.42	38
30	1	13	57.21	
40	1	13	57.59	
50	1	13	58.38	
2. 0	1	13	59.15	
10	1	13	59.54	″
20	2	14	0 .32	39
30	2	14	1 .11	
40	2	14	1 .49	
50	2	14	2 .27	
3. 0	2	14	3 . 6	
10	2	14	3 .45	″
20	2	14	4 .23	39
30	2	14	5 . 1	
50	2	14	5 .39	
50	2	14	6 .18	
4. 0	2	14	6 .57	
10	2	14	7 .36	″
20	2	14	8 .15	39
30	2	14	8 .53	
40	2	14	9 .32	
50	2	14	10.11	

D. m.	♉ H	♍ H	Com. Pts. ′ ″	
5. 0	2	14	10.49	
10	2	14	11.28	″
20	2	14	12. 7	39
30	2	14	12.46	
40	2	14	13.25	
50	2	14	14. 4	
6. 0	2	14	14.42	
10	2	14	15.21	″
20	2	14	16. 0	39
30	2	14	16.39	
40	2	14	17.18	
50	2	14	17.57	
7. 0	2	14	18.35	
10	2	14	19.14	″
20	2	14	19.53	39
30	2	14	20.32	
40	2	14	21.11	
50	2	14	21.50	
8. 0	2	14	22.29	
10	2	14	23. 8	″
20	2	14	23.47	39
30	2	14	24.26	
40	2	14	25. 5	
50	2	14	25.44	
9. 0	2	14	26.24	
10	2	14	27. 3	″
20	2	14	27.41	39
30	2	14	28.20	
40	2	14	28.59	
50	2	14	29.38	

D. m.	♉ H	♏ H	Com. Pts. ' ''	
10.0	2	14	30.19	
10	2	14	30.59	''
20	2	14	31.38	39
30	2	14	32.17	
40	2	14	33. 7	
50	2	14	33.46	
11.0	2	14	34.15	
10	2	14	34.54	''
20	2	14	35.34	39
30	2	14	36.13	
40	2	14	36.51	
50	2	14	37.31	
12.0	2	14	38.11	
10	2	14	38.51	''
20	2	14	39.31	40
30	2	14	40.11	
40	2	14	40.51	
50	2	14	41.31	
13.0	2	14	42. 9	
10	2	14	42.49	''
20	2	14	43.29	40
30	2	14	44. 8	
40	2	14	44.48	
50	2	14	45.27	
14.0	2	14	46. 7	
10	2	14	46.47	''
20	2	14	47.27	40
30	2	14	48. 6	
40	2	14	48.46	
50	2	14	49.25	

D m.	♉ H	♏ H	Com. pts. ' ''	
15.0	2	14	50. 5	
10	2	14	50.45	''
20	2	14	51.25	40
30	2	14	52. 5	
40	2	14	52.45	
50	2	14	53.25	
16.0	2	14	54. 5	
10	2	14	54.45	''
20	2	14	55.25	40
30	2	14	56. 5	
40	2	14	56.45	
50	2	14	57.25	
17.0	2	14	58. 5	
10	2	14	58.45	''
20	2	14	59.25	40
30	3	15	0. 5	
40	3	15	0.46	
50	3	15	1.26	
18.0	3	15	2. 6	
10	3	15	2.46	''
20	3	15	3.27	40
30	3	15	4. 7	
40	3	15	4.47	
50	3	15	5.28	
19.0	3	15	6. 8	
10	3	15	6.49	''
20	3	15	7.29	40
30	3	15	8.10	
40	3	15	8.50	
50	3	15	9.30	

	♉	♏	Com. pts		
D. m.	H	H	'	''	
20. 0	3	15	10	10	
10	3	15	10	51	''
20	3	15	11	30	41
30	3	15	12	11	
40	3	15	12	51	
50	3	15	13	32	
21. 0	3	15	14	13	
10	3	15	14	53	''
20	3	15	15	34	41
30	3	15	16	15	
40	3	15	16	55	
50	3	15	17	36	
22. 0	3	15	18	17	
10	3	15	18	58	
20	3	15	19	39	''
30	3	15	20	20	41
40	3	15	21	1	
50	3	15	21	41	
23. 0	3	15	22	22	
10	3	15	23	03	
20	3	15	23	44	''
30	3	15	24	25	41
40	3	15	25	06	
50	3	15	25	47	
24. 0	3	15	26	27	
10	3	15	27	08	
20	5	15	27	49	''
30	3	15	28	30	41
40	3	15	29	11	
50	3	15	29	52	

	♉	♏	Com. pts		
D. m.	H	H	'	''	
25. 0	3	15	30	33	
10	3	15	31	14	
20	3	15	31	55	''
30	3	15	32	36	41
40	3	15	33	17	
50	3	15	33	58	
26. 0	3	15	34	40	
10	3	15	35	21	
20	3	15	36	02	''
30	3	15	36	44	41
40	3	15	37	25	
50	3	15	38	06	
27. 0	3	15	38	47	
10	3	15	39	29	
20	3	15	40	11	''
30	3	15	40	53	41
40	3	15	41	34	
50	3	15	42	15	
28. 0	3	15	42	55	
10	3	15	43	37	
20	3	15	44	19	''
30	3	15	45	01	41
40	3	15	45	43	
50	3	15	46	21	
29. 0	3	15	47	4	
10	3	15	47	46	
20	3	15	48	28	''
30	3	15	49	10	42
40	3	15	49	52	
50	3	15	50	33	

D.	m.	II H	H	Com. Pts. ′ ″	
0.	0	3	15	51.14	
	10	3	15	51.56	″
	20	3	15	52.37	42
	30	3	15	53.19	
	40	3	15	54. 0	
	50	3	15	54 42	
1.	0	3	15	55.24	
	10	3	15	56. 6	″
	20	3	15	56.47	42
	30	3	15	57.29	
	40	3	15	58.10	
	50	3	15	58.52	
2.	0	3	15	59.35	
	10	4	16	00.17	″
	20	4	16	00.59	42
	30	4	16	01.40	
	40	4	16	2 .22	
	50	4	16	3 . 4	
3.	0	4	16	3.46	
	10	4	16	4.28	″
	20	4	16	5. 9	42
	30	4	16	5.51	
	40	4	16	6.33	
	50	4	16	7.15	
4.	0	4	16	7.59	
	10	4	16	8.41	″
	20	4	16	9.23	42
	30	4	16	10. 5	
	40	4	16	10.47	
	50	4	16	11.29	

D.	m.	II H	H	Com. pts. ′ ″	
5.	0	4	16	12.11	
	10	4	16	12.53	″
	20	4	16	13.35	42
	30	4	16	14.17	
	40	4	16	14.59	
	50	4	16	15.41	
6.	0	4	16	16.25	
	10	4	16	17. 7	″
	20	4	16	17.50	42
	30	4	16	18.32	
	40	4	16	19.15	
	50	4	16	19.57	
7.	0	4	16	20.39	
	10	4	16	21.21	″
	20	4	16	22. 4	43
	30	4	16	22.47	
	40	4	19	23.30	
	50	4	16	24.12	
8.	0	4	16	24.54	
	10	4	16	25.36	″
	20	4	16	26.19	43
	30	4	16	27. 1	
	40	4	16	27.44	
	50	4	16	28.26	
9.	0	4	16	29. 9	
	10	4	16	29.51	″
	20	4	16	30.34	43
	30	4	16	31.16	
	40	4	16	31.59	
	50	4	16	32.42	

D. m.	II H	♃ H	Com. pu ′ ″	
10.0	4	16	33.25	
10	4	16	34. 8	″
20	4	16	34.51	43
30	4	16	35.34	
40	4	16	36.15	
50	4	16	36.58	
11.0	4	16	37.41	
10	4	16	38.24	″
20	4	16	39. 7	43
30	4	16	39.49	
40	4	16	40.32	
50	4	16	41.14	
12.0	4	16	41.57	
10	4	16	42.40	″
20	4	16	43.23	43
30	4	16	44.05	
40	4	16	44.48	
50	4	16	45.31	
13.0	4	16	46.15	
10	4	16	46.58	″
20	4	16	47.41	43
30	4	16	48.23	
40	4	16	49. 5	
50	4	16	49.48	
14.0	4	16	50.32	
10	4	16	51.15	″
20	4	16	51.58	43
30	4	16	52.41	
40	4	16	53.23	
50	4	16	54. 5	

D. m.	II H	♃ H	Com. pu ′ ″	
15. 0	4	16	54.51	
10	4	16	55.34	″
20	4	16	56.17	43
30	4	16	57.00	
40	4	16	57.43	
50	4	16	58.26	
16. 0	4	16	59. 9	
10	4	16	59.52	″
20	5	6	00.35	43
30	5	6	1.18	
40	5	6	2.01	
50	5	6	2.44	
17. 0	5	17	3.28	
10	5	17	4.11	″
20	5	17	4.54	43
30	5	17	5.37	
40	5	17	6.20	
50	5	17	7.04	
18. 0	5	17	7.48	
10	5	17	8.31	″
20	5	17	9.14	43
30	5	17	9.58	
40	5	17	10.41	
50	5	17	11.24	
19. 0	5	17	12. 8	
10	5	17	12.52	″
20	5	17	13.35	43
30	5	17	14.18	
40	5	17	15.01	
50	5	17	15.44	

D. m.	♊ H	♐ H	Com. Pts. ' ''	
20.0	5	17	16.28	
10	5	17	17.12	''
20	5	17	17.55	44
30	5	17	18.39	
40	5	17	19.23	
50	5	17	20. 5	
21.0	5	17	20.48	
10	5	17	21.32	''
20	5	17	22 15	44
30	5	17	22.59	
40	5	17	23.42	
50	5	17	24.26	
22.0	5	17	25. 9	
10	5	17	25 53	''
20	5	17	26.37	44
30	5	17	27.21	
40	5	17	28 04	
50	5	17	28.47	
23.0	5	17	29.30	
10	5	17	30.14	''
20	5	17	30.58	44
30	5	17	31.41	
40	5	17	32.25	
50	5	17	33.08	
24.0	5	17	33.51	
10	5	17	34.35	''
20	5	17	35.18	44
30	5	17	36.02	
40	5	17	36.46	
50	5	17	37.30	

D. m.	♊ H	♐ H	Com. Pts. ' ''	
25.0	5	17	38.12	
10	5	17	38.56	''
20	5	17	39.39	44
30	5	17	40.23	
40	5	17	41.06	
50	5	17	41.50	
26.0	5	17	42.33	
10	5	17	43 17	''
20	5	17	44.00	44
30	5	17	44 44	
40	5	17	45.27	
50	5	17	46.11	
27.0	5	17	46.55	
10	5	17	47.39	''
20	5	17	48.22	44
30	5	17	49.06	
40	5	17	49.49	
50	5	17	50.33	
28.0	5	17	51.17	
10	5	17	52.01	''
20	5	17	52 44	44
30	5	17	53.27	
40	5	17	54.11	
50	5	17	54.54	
29.0	5	17	55.38	
10	5	17	56 22	''
20	5	17	57.06	44
30	5	17	57.49	
40	5	17	58.33	
50	5	17	59.16	

D.	m.	♋ H	♈ H	Com. Pts. H,	m	D
0.	0	6	18	0.	0	
	10	6	18	00.	44	″
	20	6	18	1.	27	44
	30	6	18	2.	05	
	40	6	18	2.	44	
	50	6	18	3.	28	
1.	0	6	18	4.	22	
	10	6	18	5	06	″
	20	6	18	5	50	44
	30	6	18	6.	34	
	40	6	18	7	18	
	50	6	18	8.	02	
2.	0	6	18	8.	43	
	10	6	18	9.	26	″
	20	6	18	10.	10	44
	30	6	18	10.	54	
	40	6	18	11.	37	
	50	6	18	12.	20	
3.	0	6	18	13.	5	
	10	6	18	13.	49	″
	20	6	18	14.	32	44
	30	6	18	15.	16	
	40	6	18	15.	59	
	50	6	18	16.	43	
4.	0	6	18	17.	27	
	10	6	18	18.	11	″
	20	6	18	18.	54	44
	30	6	18	19.	38	
	40	6	18	20.	22	
	50	6	18	21.	05	

D.	m.	♋ H	♈ H	Com. Pts. H,	m	D
5.	0	6	18	21.	48	
	10	6	18	22.	32	″
	20	6	18	23.	15	
	30	6	18	23.	59	44
	40	6	18	24.	42	
	50	6	18	25.	25	
6.	0	6	18	26.	9	
	10	6	18	26.	53	″
	20	6	18	27.	37	
	30	6	18	28.	20	44
	40	6	18	29.	04	
	50	6	18	29.	47	
7.	0	6	18	30.	30	
	10	6	18	31.	14	″
	20	6	18	31.	57	
	30	6	18	32.	41	44
	40	6	18	33.	24	
	50	6	18	34.	17	
8.	0	6	18	34.	51	
	10	6	18	35.	34	″
	20	6	18	36.	18	
	30	6	18	37.	01	44
	40	6	18	37.	45	
	50	6	18	38.	28	
9.	0	6	18	39.	11	
	10	6	18	39.	54	
	20	6	18	40.	48	″
	30	6	18	41.	31	44
	40	6	18	42.	15	
	50	6	18	42.	58	

D.	m.	♋ H	♑ H	Com. Pts. ° H	'' m	
10.	0	6	18	43	32	
	10	6	18	44	15	''
	20	6	18	44	59	43
	30	6	18	45	42	
	40	6	18	46	25	
	50	6	18	47	9	
11.	0	6	18	47	52	
	10	6	18	48	35	''
	20	6	18	49	18	43
	30	6	18	50	2	
	40	6	18	50	45	
	50	6	18	51	29	
12.	0	6	18	52	12	
	10	6	18	52	55	''
	20	6	18	53	38	43
	30	6	18	54	22	
	40	6	18	55	5	
	50	6	18	55	48	
13.	0	6	18	56	31	
	10	6	18	57	14	''
	20	6	18	57	57	43
	30	6	18	58	41	
	40	6	18	59	24	
	50	7	19	0	7	
14.	0	7	19	0	50	
	10	7	19	1	33	
	20	7	19	2	16	''
	30	7	19	3	0	43
	40	7	19	3	43	
	50	7	19	4	26	

D.	m.	♋ H	♑ H	Com. Pts. ° H	'' m	
15.	0	7	19	5	9	
	10	7	19	5	52	''
	20	7	19	6	35	43
	30	7	19	7	18	
	40	7	19	8	1	
	50	7	19	8	44	
16.	0	7	19	9	27	
	10	7	19	10	10	''
	20	7	19	10	53	43
	30	7	19	11	36	
	40	7	19	12	19	
	50	7	19	13	2	
17.	0	7	19	13	45	
	10	7	19	14	28	''
	20	7	19	15	11	43
	30	7	19	15	54	
	40	7	19	16	36	
	50	7	19	17	19	
18.	0	7	19	18	2	
	10	7	19	18	45	''
	20	7	19	19	28	43
	30	7	19	20	11	
	40	7	19	20	53	
	50	7	19	21	36	
19.	0	7	19	22	19	
	10	7	19	23	2	''
	20	7	19	23	45	43
	30	7	19	24	27	
	40	7	19	25	10	
	50	7	19	25	53	

D. m.	♋ H	♑ H	Com. Pn. ′ ″	
20. 0	7	19	26.35	
10	7	19	27.18	″
20	7	19	28. 0	
30	7	19	28.43	43
40	7	19	29.25	
50	7	19	30. 8	
21. 0	7	19	30.51	
10	7	19	31.34	″
20	7	19	32.16	43
30	7	19	32.59	
40	7	19	33.41	
50	7	19	34.24	
22. 0	7	19	35. 6	
10	7	19	35.49	″
20	7	19	36.31	43
30	7	19	37.14	
40	7	19	37.56	
50	7	19	38.39	
23. 0	7	19	39.21	
10	7	19	40. 3	″
20	7	19	40.46	42
30	7	19	41.28	
40	7	19	42.10	
50	7	19	42.52	
24. 0	7	19	43.35	
10	7	19	44.17	
20	7	19	45. 0	″
30	7	19	45.42	42
40	7	19	46.24	
50	7	19	47. 7	

D. m.	♋ H	♑ H	Com. Pn. ′ ″	
25. 0	7	19	47.49	
10	7	19	48.31	″
20	7	19	49.13	42
30	7	19	49.56	
40	7	19	50.38	
50	7	19	51.20	
26. 0	7	19	52.01	
10	7	19	52.43	″
20	7	19	53.25	42
30	7	19	54. 7	
40	7	19	54.50	
50	7	19	55.32	
27. 0	7	19	56.13	
10	7	19	56.55	″
20	7	19	57.37	42
30	7	19	58.20	
40	7	19	59. 2	
50	7	19	59.43	
28. 0	8	20	0.25	
10	8	20	1. 7	″
20	8	20	1.49	42
30	8	20	2.30	
40	8	20	3.12	
50	8	20	3.54	
29. 0	8	20	4.36	
10	8	20	5.18	″
20	8	20	6. 0	42
30	8	20	6.41	
40	8	20	7.23	
50	8	20	8. 4	

D.	m.	♌ H	♒ H	Com. pu. ′ ″	
0.	0	8	30	8.48	
	10	8	20	9.28	″
	20	8	20	10.10	42
	30	8	20	10.52	
	40	8	20	11.34	
	50	8	20	12.16	
1.	0	8	20	12.55	
	10	8	20	13.36	″
	20	8	20	14.17	41
	30	8	20	14.58	
	40	8	20	15.39	
	50	8	20	16.20	
2.	0	8	20	17. 4	
	10	8	20	17.45	″
	20	8	20	18.26	41
	30	8	20	19.07	
	40	8	20	19.48	
	50	8	20	20.29	
3.	0	8	20	21.12	
	10	8	20	21.53	″
	20	8	20	22.34	41
	30	8	20	23.15	
	40	8	20	23.56	
	50	8	20	24 37	
4.	0	8	20	25.20	
	10	8	20	26.01	
	20	8	20	26.42	″
	30	8	20	27.23	41
	40	8	20	28.04	
	50	8	20	28.45	
5.	0	8	20	29.27	
	10	8	20	30 08	″
	20	8	20	30.49	41
	30	8	20	31.30	
	40	8	20	32.11	
	50	8	20	32.52	
6.	0	8	20	33.33	
	10	8	20	34.14	″
	20	8	20	34.55	41
	30	8	20	35.36	
	40	8	20	36.17	
	50	8	20	36.58	
7.	0	8	20	37.38	
	10	8	20	38.19	″
	20	8	20	39.00	41
	30	8	20	39.41	
	40	8	20	40.22	
	50	8	20	41.03	
8.	0	8	20	41.42	
	10	8	20	42.23	″
	20	8	20	43.04	41
	30	8	20	43.45	
	40	8	20	44.26	
	50	8	20	45.07	
9.	0	8	20	45.46	
	10	8	20	46.26	″
	20	8	20	47.06	40
	30	8	20	47 46	
	40	8	20	48.26	
	50	8	20	49.06	

			Com. pts		
D. m.	H	[illegible]	H	[illegible]	D
10.0	8	30	49.50		5
10	8	20	50.30		11
20	8	20	51.10		40
30	8	20	51.50		
40	8	20	52.30		
50	8	20	53.10		
11.0	8	20	53.35		6
10	8	20	54.35		11
20	8	20	55.15		40
30	8	20	55.55		
40	8	20	56.35		
50	8	20	57.15		
12.0	8	20	57.95		7
10	8	20	58.95		11
20	8	20	59.15		40
30	8	20	59.95		
40	9	21	60.95		
50	9	21	1.75		
13.0	9	21	1.95		8
10	9	21	2.95		11
20	9	21	3.05		40
30	9	21	3.55		
40	9	21	4.35		
50	9	21	5.25		
14.0	9	21	5.95		9
10	9	21	6.95		11
20	9	21	7.25		40
30	9	21	7.55		
40	9	21	8.35		
50	9	21	9.15		

			Com. pts		
D. m.	H	[illegible]	H	[illegible]	D
15.0	9	21	9.55		0
10	9	21	10.35		11
20	9	21	81.15		40
30	9	21	81.55		
40	9	21	82.35		
50	9	21	83.15		
16.0	9	21	83.53		1
10	9	21	84.22		11
20	9	21	85.62		40
30	9	21	85.82		
40	9	21	86.22		
50	9	21	87.62		
17.0	9	21	87.51		2
10	9	21	18.81		11
20	9	21	89.61		40
30	9	21	19.51		
40	9	21	20.81		
50	9	21	21.11		
18.0	9	21	21.48		3
10	9	21	22.27		11
20	9	21	23.06		39
30	9	21	23.45		
40	9	21	24.24		
50	9	21	25.03		
19.0	9	21	25.45		4
10	9	21	26.24		11
20	9	21	27.03		39
30	9	21	27.42		
40	9	21	28.21		
50	9	21	29.00		

D.	m.	H	H	Com.	pts.	G
20.	0	9	21	29.	41	
	10	9	21	30.	20	''
	20	9	21	30.	59	39
	30	9	21	31.	38	
	40	9	21	32.	17	
	50	9	21	32.	56	
21.	0	9	21	33.	36	
	10	9	21	34.	15	''
	20	9	21	34.	54	39
	30	9	21	35.	33	
	40	9	21	36.	12	
	50	9	21	36.	51	
22.	0	9	21	37.	30	
	10	9	21	38.	9	''
	20	9	21	38.	48	39
	30	9	21	39.	27	
	40	9	21	40.	06	
	50	9	21	40.	45	
23.	0	9	21	41.	24	
	10	9	21	42.	03	''
	20	9	21	42.	42	39
	30	9	21	43.	21	
	40	9	21	44.	00	
	50	9	21	44.	39	
24.	0	9	21	45.	17	
	10	9	21	45.	56	''
	20	9	21	46.	35	39
	30	9	21	47.	14	
	40	9	21	47.	53	
	50	9	21	48.	32	

D	m.	H	H	Com.	pts.	C
25.	0	9	21	49.	11	
	10	9	21	49.	50	''
	20	9	21	50.	29	39
	30	9	21	51.	08	
	40	9	21	51.	47	
	50	9	21	52.	26	
26.	0	9	21	53.	02	
	10	9	21	53.	41	''
	20	9	21	54.	19	39
	30	9	21	54.	58	
	40	9	21	55.	36	
	50	9	21	56.	14	
27.	0	9	21	56	53	
	10	9	21	57.	32	''
	20	9	21	58.	10	39
	30	9	21	58.	49	
	40	9	21	59.	27	
	50	10	22	00.	06	
28.	0	10	22	0.	44	
	10	10	22	1.	22	''
	20	10	22	2.	00	38
	30	10	22	2.	39	
	40	10	22	3.	19	
	50	10	22	3.	55	
29.	0	10	22	4.	34	
	10	10	22	5.	12	''
	20	10	22	5.	50	38
	30	10	22	6.	29	
	40	10	22	7.	08	
	50	10	22	7.	46	

D.	m.	♍ H	♓ H	Com. Pts. ′	″	
0.	0	10	22	8.	24	
	10	10	22	9.	02	″
	20	10	22	9.	40	38
	30	10	22	10.	19	
	40	10	22	10.	57	
	50	10	22	11.	35	
1.	0	10	22	12.	13	
	10	10	22	12.	51	″
	20	10	22	13.	29	38
	30	10	22	14.	07	
	40	10	22	14.	45	
	50	10	22	15.	23	
2.	0	10	22	16.	1	
	10	10	22	16.	39	″
	20	10	22	17.	17	38
	30	10	22	17.	55	
	40	10	22	18.	33	
	50	10	22	19.	11	
3.	0	10	22	19.	49	
	10	10	22	20.	27	″
	20	10	22	21.	05	38
	30	10	22	21.	43	
	40	10	22	22.	21	
	50	10	22	22.	59	
4.	0	10	22	23.	36	
	10	10	22	24.	14	″
	20	10	22	24.	52	38
	30	10	22	25.	30	
	40	10	22	26.	08	
	50	10	22	26.	46	
5.	0	10	22	27.	23	
	10	10	22	28.	01	″
	20	10	22	28.	39	38
	30	10	22	29.	16	
	40	10	22	29.	54	
	50	10	22	30.	32	
6.	0	10	22	31.	9	
	10	10	22	31.	46	″
	20	10	22	32.	24	38
	30	10	22	33.	01	
	40	10	22	33.	39	
	50	10	22	34.	17	
7.	0	10	22	34	55	
	10	10	22	35.	33	″
	20	10	22	36.	10	38
	30	10	22	36.	48	
	40	10	22	37.	25	
	50	10	22	38.	03	
8.	0	10	22	38	40	
	10	10	22	39.	18	″
	20	10	22	39.	56	38
	30	10	22	40	33	
	40	10	22	41.	10	
	50	10	22	41.	48	
9.	0	10	22	42	25	
	10	10	22	43.	02	″
	20	10	22	43.	40	38
	30	10	22	44.	17	
	40	10	22	44.	54	
	50	10	22	45.	32	

D. m.	♍ H	♓ H	Com. Pts. ' ''	
10.0	10	22	46.10	
10	10	22	46.47	''
20	10	22	47.25	37
30	10	22	48.03	
40	10	22	48.40	
50	10	22	49.17	
11.0	10	22	49.54	
10	10	22	50.31	''
20	10	22	51.09	37
30	10	22	51.46	
40	10	22	52.23	
50	10	22	53.01	
12.0	10	22	53.38	
10	10	22	54.15	''
20	10	22	54.52	37
30	10	22	55.29	
40	10	22	56.07	
50	10	22	56.44	
13.0	10	22	57.21	
10	10	22	57.58	''
20	10	22	58.34	37
30	10	22	59.12	
40	10	22	59.49	
50	11	23	00.27	
14.0	11	23	1. 4	
10	11	23	1.41	''
20	11	23	2.18	37
30	11	23	2.55	
40	11	23	3.32	
50	11	23	4.09	

D m	♍ H	♓ H	Com. pts ' ''	
15.0	11	23	4.47	
10	11	23	5.24	''
20	11	23	6.01	37
30	11	23	6.39	
40	11	23	7.16	
50	11	23	7.53	
16.0	11	23	8.29	
10	11	23	9.06	''
20	11	23	9.43	37
30	11	23	10.20	
40	11	23	10.57	
50	11	23	11.34	
17.0	11	23	12.11	
10	11	23	12.48	''
20	11	23	13.25	37
30	11	23	14.02	
40	11	23	14.39	
50	11	23	15.16	
18.0	11	23	15.53	
10	11	23	16.30	''
20	11	23	17.07	37
30	11	23	17.44	
40	11	23	18.21	
50	11	23	18.58	
19.0	11	23	19.34	
10	11	23	20.11	''
20	11	23	20 48	37
30	11	23	21.25	
40	11	23	22.02	
50	11	23	22 39	

D. m.	♍ H	♐ H	Com. Pts. '	''	
20. 0	11	23	23	16	
10	11	23	23	53	
20	11	23	24	30	''
30	11	23	25	07	37
40	11	23	25	44	
50	11	23	26	21	
21. 0	11	23	26	56	
10	11	23	27	33	
20	11	23	28	10	''
30	11	23	28	46	37
40	11	23	29	23	
50	11	23	30	00	
22. 0	11	23	30	37	
10	11	23	31	14	
20	11	23	31	51	''
30	11	23	32	27	37
40	11	23	33	04	
50	11	23	33	41	
23. 0	11	23	34	18	
10	11	23	34	55	
20	11	23	35	32	''
30	11	23	36	08	37
40	11	23	36	45	
50	11	23	37	22	
24. 0	11	23	37	59	
10	11	23	38	36	
20	11	23	39	13	''
30	11	23	39	59	37
40	11	23	40	36	
50	11	23	41	13	

D m.	H	♐ H	Com. pts. '	''	
25. 0	11	23	41	40	
10	11	23	42	17	
20	11	23	42	54	''
30	11	23	43	30	37
40	11	23	44	07	
50	11	23	44	43	
26. 0	11	23	45	20	
10	11	23	45	57	
20	11	23	46	34	''
30	11	23	47	10	37
40	11	23	47	47	
50	11	23	48	23	
27. 0	11	23	49	0	
10	11	23	49	37	
20	11	23	50	14	''
30	11	23	50	50	37
40	11	23	51	27	
50	11	23	52	03	
28. 0	11	23	52	40	
10	11	23	53	17	
20	11	23	53	54	''
30	11	23	54	30	37
40	11	23	55	06	
50	11	23	55	43	
29. 0	11	23	56	20	
10	11	23	56	57	
20	11	23	57	34	''
30	11	23	58	10	37
40	11	23	58	46	
50	11	23	59	23	

A Catalogue of ſome Noted fix'd Stars, with their *Temporary Right Aſcenſions* to the Year 1686.

The firſt Column ſhews their Magnitudes. The ſecond *Bayer*'s Notes. The third the Numbers in *Ticho*'s Catalogue. The fourth *Bayer*'s Latin Names, and common Engliſh Names. The fifth their Temporary Right Aſcenſions.

Mag	Not. Bay.	Num Cat. Tich	Stars Names.	Rt. Aſcenſ H. ′ ″
3	ι	21	*In Extremitate Boreali Canda Ceti* Northern in the Whales Tail	00.03.32
2	β	22	*In Extremitate Auſtrali Canda Ceti* Southern in the Whales Tail	00.28.17
3	η	16	*Pracedens in Eductione Canda Ceti* Weſtern in the Back of the Whale	00.54.13
3	θ	15	*Sequens in Eductione Canda Ceti* Eaſtern in the Back of the Whale	01.08.40
3	ζ	14	*In medio corpore Ceti trium Septentrionalior* Northern in the Whales Belly	01.36.05
4	γ	1	*Prima Stella Arietis* Firſt Star of Aries	01.36.22
4	β	2	*In ſiniſtro Cornu Arietis* Second Star of Aries	01.37.04
3	α	19	*In Nodo Vinculorum Piſcium* Br * in the Knot of the Fiſhes Line	01.45.49
3	α	14	*Lucida Arietis* Bright Star of Aries	01.49.29
3	δ	4	*Trium in Collo Ceti Auſtralior* In the Whales Cheek	02.23.43
3	ε	10	*Lateris Sequentis Quadrilateri Borea in Pectore Ceti* On the Whales Breſt	02.24.40
3	γ	3	*Media Trium in Collo Ceti* In the Whales Mouth.	02.27.16

				h ' ''
2	α	2	*Lucida in Naribus, Menkar, Ceti* Whales Jaw	02.45.50
3	[illegible]	32	*Lucida Pleiadum Tauri* Brighteſt of the Pleiades	03.29.01
3	γ	11	*In Vultu Tauri illa in Naribus* The loweſt of the Hyades	04.01.50
3	[illegible]	15	*Ad Oculum Boreum Tauri* North Eye of Taurus	04:10.08
1	α	14	*Tauri Oculus Auſtrinus. Aldebaran* Bulls South Eye	04.17.56
3	β	2	*Supra Pedem Orionis in Flumine Erid.* Orions Foot in Eridanus	04.52.32
1	β	35	*Pes Dexter Orionis. Rigel* Bright Star in Orions Foot	04.59 29
2	β		*Tauri Cornu Septentrionale* Bulls North Horn	05.06.27
2	γ	3	*In humero Dextro Orionis Duarum Borealior* Firſt or left Shoulder of Orion	05 08.22
2	δ	26	*In Baltheo Orionis Fulgentium 3um precedens* Firſt in Orions Belt	05.15.55
3	ζ	19	*Extrema Cornu Auſtralis Tauri* Bulls South Horn	05.18.50
2	ε	27	*Media Balthei Orionis* The ſecond or middle in Orions Belt	05.20.08
2	ζ	28	*Sequens ſeu tertia Balthei Orionis* Third or laſt in Orions Belt	05:24.30
1	α	2	*Lucida in Humero ſiniſtro Orionis* The latter or right Shoulder of Orion	05.38.07
3	[illegible]	15	*Calx Caſtoris* The Heel of Gemini	05.56.05

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2	β	9	*In Collario Canis Majoris* The fore-foot of the Great Dog	06.09.13
2	γ	17	*In summo Pede sinistro sequentis* ♊ Bright Star on the Foot of ♊	06.19.25
1	α	1	*Syrius seu Canis Major* The Great Dog Star	06.31.11
3	ζ	11	*In Dextro Genu Herculis* ♊ Left Knee of Gemini	06.45.38
3	γ	4	*Ad Aurem Dextram Canis Majoris* On the Neck of Canis Major	07.11.00
1	α	2	*Procyon seu Canis Minor* The Little Dog	07.22.53
2	α	12	*Cor Hydræ, Alphard* Hydra's Heart	09.12.07
3	[illegible]	7	*Trium in Cervice Leonis Australior* Southern in the Neck of Leo	09.50.22
1	α	8	*Lor Leonis* Lions Heart	09.51.31
3	ζ	5	*Trium in Cervice Leonis Borealior* Northern in the Neck of Leo	09.59.06
2	γ	6	*Trium in Cervice Leonis Media. Juba* Lions Creſt	10.02.27
2	δ	20	*In Lumbis Leonis Ducarum quæ Sequitur* In the Loyn of Leo	10.57.21
3	θ	21	*In Vertebra Femoris Dextri Leonis* On the Buttock of Leo	10.57.50
1	β	27	*Cauda Leonis* Lions Tail	11.32.58
3	ι	23	*In Femore Dextro Leonis* On the Thigh of Leo	11.07.44

				h ′ ″
3	β	5	*In Extremo Ala ſiniſtra Virginis* Above the left wing of Virgo	11.34.31
3	γ	7	*Sub ſtrophio ſeu Caſtula Virginis* On the left wing of Virgo	12.25.43
3	δ	10	*Ad Cingulum Virginis* In the Girdle of Virgo	12.39.58
3	ε	13	*Ala Dextra ♍ precedens. Vindemiatrix* Virgo’s right wing. Vindemiatrix	12.46.46
1	α	14	*Spica Virginis* Virgins Spike	13.08.46
3	ζ	15	*Sub Perizomate ad pedem dextrum ♍* On the Buttock of Virgo	13.13.38
3	η	20	*In ſiniſtra Tibia Bootis trium Borealior* Moſt Northern on the left knee of Bootes	13.32.33
1	α	23	*Arcturus* Arcturus	14.01.24
3	ζ	19	*In Dextra Tibia Bootis* Bend of Bootes right knee	14.26.20
2	α	1	*Lanx Auſtralis* Southern Ballance	14.33.46
2	β	3	*Lanx Borealis* Northern Ballance	15.00.15
3	γ	7	*In media lance Boreali Prima & Superior* Middle of the Northern Ballance	15.18.13
2	α	9	*Precedens trium in medio neru colli ſerpentis* Bright Star in the Serpents neck	15.28.54
2	β	1	*In fronte ♏ ad Boream prima fulgens* Higheſt in Scorpio’s forehead	15.46.04
3	δ	2	*In dextra manu ſerpentarii Borealior* Northern in the left hand of Serpentarius	15.58.23

				h ′ ″
3	γ	5	*Ad Originem Alæ Dextræ Aquilæ* Pinion of Aquila's Right Wing	19.31.38
2	α	3	*Lucida in Eductione Colli Aquilæ* Aquila's Bright Star	19.35.51
3	β	2	*In Collo Aquilæ* Neck of Aquila	19.39.57
3	α	1	*Septentrionalis duplex in Cornu Capricorn* Northern in the Horn of Capricorn	20.00.50
3	ε	1	*Lucida Caudæ Delphini trium Antecedens.* Dolphins Tail	20.18.23
3	β	4	*In Humero Dextro Aquarii* Left Shoulder of Aquary	21.14.58
3	γ	23	*In Eductione Caudæ Capricorni Antecedens* First in the Tail of Capricorn	21.22.57
3	ε	1	*In Rictu Pegaſi. Enif.* Mouth of Pegaſus	21.28.44
3	δ	24	*In Eductione Caudæ Capricorni ſuccedens* Laſt in the Tail of Capricorn	21.30.07
3	α	2	*Humerus ſiniſter Aquarii* Right Shoulder of Aquary	21.49.43
3	γ	9	*In Lævo Cubito Aquarii* Right Elbow of Aquary	22.05.37
3	δ	18	*In ſiniſtra Tibia Aquarii* Right ſhin or knee of Aquary	22.38.15
2	β	18	*In Eductione Cruris Pegaſi. Scheat* Pegaſus Thigh	22.48.43
2	α	17	*Ala Pegaſi. Marchab* Pegaſus Wing	22.49.05
2	γ	19	*In Extrema Ala Pegaſi* End of Pegaſus Wing	23.57.03

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3	[illegible]	8	*Auſtralior in Dextra manu Serpentarii* Southern in the left hand of Serpentarius	16.01.57
3	γ	3	*In ſiniſt. Humero Herculis trium Auſtralior* Hercules Right Shoulder	16.08.07
1	α	8	*Cor Scorpii* Scorpius Heart	16.10.18
3	β	2	*In ſiniſt. Humero Herculis trium Borealior* Northern in Hercules Right Shoulder	16.16.41
3	ζ	19	*In Femore Dextro Serpentarii* Serpentarius left knee	16.19.59
3	θ	13	*In Femore ſiniſtro Serpentarii* 3um *Borealior* Right Ham of Serpentarius	16.52.02
3	α	1	*Caput Herculis* Hercules Head	17.00.23
3	δ	5	*Herculis Humerus Dexter* Left Shoulder of Hercules	17.01.57
2	α	1	*Caput Serpentarii* Serpentarius Head	17.20.22
3	β	2	*In ſiniſt. Humero Serpentarii* 2rum *Superior* Northern in Serpentarius right Shoulder	17.27.55
3	γ	3	*In eodem duarum Inferior* Southern in Serpentarius Right Shoulder	17.32.23
3	ζ	16	*Prima poſt Serpentarium in Cauda Serpentis* Laſt but two in the Serpents Tail	17.44.09
3	[illegible]	17	*In Penultima Flexione Caudæ Serpentis* Laſt but one in the Serpents Tail	18.05 20
3	θ	18	*Extrema Cauda Serpentis* Laſt in the Serpents Tail	18.40 37
3	[illegible]	11	*Extrema Cauda Aquilæ* Laſt in the Eagles Tail	18.51.06

TABLES
OF
ÆQUATION
OF
Natural Days.

A Table of Equation of Natural Days.

Day	Jan.	Dif.	Feb.	X	March	X	Apr.	X	May	X	June	X
	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″
1	8 . 55	22	14 . 54	1	10 . 16	18	0 . 51	16	4 : 12	2	1 . 10	13
2	9 . 17	23	14 . 53	2	9 . 58	18	0 . 35	17	4 . 14	2	0 . 57	12
3	9 . 40	22	14 . 51	3	9 . 41	17	0 . 18	17	4 . 16	1	0 . 45	12
4	10 . 02	21	14 . 48	3	9 . 24	17	0 * 01	15	4 . 17	1	0 . 33	14
5	10 : 23		14 . 45		9 . 06	18	0 . 14		4 . 16		0 . 19	
		21		5		17		15		1		12
6	10 . 44	18	14 . 40	5	8 . 49	17	0 . 29	14	4 : 15	1	0 . 07	13
7	11 . 02	18	14 . 35	6	8 . 32	18	0 . 43	15	4 . 14	2	0 * 06	13
8	11 . 20	18	14 . 29	6	8 . 14	19	0 . 58	14	4 . 12	2	0 . 19	13
9	11 . 38	17	14 . 23	7	7 . 55	18	1 . 12	14	4 . 10	2	0 . 32	12
10	11 . 55		14 . 16		7 . 37		1 . 26		4 . 08		0 . 44	
		17		9		19		14		3		13
11	12 . 12	16	14 . 07	8	7 . 18	20	1 . 40	12	4 . 05	4	0 . 57	13
12	12 . 28	15	13 . 59	9	6 . 58	19	1 . 52	11	4 . 01	4	1 . 10	13
13	12 . 43	15	13 . 50	9	6 . 39	19	2 . 03	12	3 . 57	5	1 . 23	13
14	12 . 58	13	13 . 41	10	6 . 20	19	2 . 15	11	3 . 52	5	1 . 36	14
15	13 . 11		13 . 31		6 . 01		2 . 26		3 . 47		1 . 50	
	Add	12	Add	11	Add	19	Subſtract	11	Subſtract	5	Add	12
16	13 . 23	12	13 . 20	11	5 . 42	15	2 . 37	11	3 . 42	7	2 . 02	12
17	13 . 35	11	13 . 09	12	5 . 23	19	2 . 48	9	3 . 35	7	2 . 14	12
18	13 . 46	11	12 . 57	12	5 . 04	19	2 . 57	9	3 . 28	7	2 . 26	12
19	13 . 57	9	12 . 45	14	4 . 46	19	3 . 06	9	3 . 21	8	2 . 38	12
20	14 . 06		12 . 31		4 . 27		3 . 15		3 . 13		2 . 50	
		9		14		19		8		9		12
21	14 . 15	8	12 . 17	13	4 . 08	18	3 . 23	7	3 . 04	8	3 . 02	12
22	14 . 23	6	12 . 04	14	3 . 50	19	3 . 30	7	2 . 56	9	3 . 14	11
23	14 . 29	6	11 . 56	13	3 . 31	19	3 . 37	7	2 . 47	10	3 . 25	10
24	14 . 35	5	11 . 37	15	3 . 12	19	3 . 44	6	2 . 37	9	3 . 35	10
25	14 . 40		11 . 22		2 . 53		3 . 50		2 . 28		3 . 45	
		4		16		18		5		10		12
26	14 . 44	4	11 . 06	16	2 . 35	19	3 . 55	4	2 . 18	11	3 . 57	10
27	14 . 48	2	10 . 50	16	2 . 16	18	3 . 59	4	2 . 07	11	4 . 07	10
28	14 . 50	1	10 . 34		1 . 58	17	4 . 03	3	1 . 56	11	4 . 17	8
29	14 . 51	1			1 . 41	17	4 . 07	3	1 . 45	11	4 . 25	8
30	14 . 52	1			1 . 24	17	4 . 10		1 . 34	12	4 . 33	
31	14 . 53				1 . 07				1 . 22			

A Table of Æquation of Natural Days.

Day	July.	X	Auguſt	X	Sept.	X	Octob.	X	Novemb	X	Decemb	X
	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″
1	4 · 43	8	4 · 36	9	3 · 41	21	13. 13	13	15. 28	8	5 · 51	28
2	4 · 51	7	4 · 27	9	4 · 02	21	13. 26	14	15. 20	9	5 · 23	28
3	4 · 58	7	4 · 18	12	4 · 23	21	13. 40	13	15. 11	10	4 · 55	29
4	5 · 5	7	4 · 06	11	4 · 44	20	13. 53	13	15. 01	10	4 · 2[illegible]	30
5	5 · 12	6	3 · 55	11	5 · 04	20	14. 06	13	14. 51	12	3 · 56	29
6	5 · 18	6	3 · 44	13	5 · 24	21	14. 19	12	14. 39	13	3 · 27 Subſtract	29
7	5 · 24	5	3 · 31	13	5 · 45	20	14. 31	11	14. 26	13	3 · 58	30
8	5 · 29	4	3 · 18	13	6 · 05	21	14. 42	10	14. 13	13	2 · 28	30
9	5 · 33	4	3 · 05	13	6 · 26	20	14. 52	09	14. 00	15	2 · 58	30
10	5 · 37	4	2 · 52	14	6 · 46	21	15. 01	9	13. 45	16	1 · 28	30
11	5 · 41	3	2 · 38 Add	14	7 · 07	21	15. 10	8	13. 29	16	0 · 58	31
12	5 · 44	2	2 · 24	16	7 · 28	21	15. 18	8	13. 13	17	0 · 28	30
13	5 · 46	2	2 · 08	16	7 · 49	20	15 26	8	12. 56	18	0 · 03	30
14	5 · 48	1	1 · 52	16	8 · 09	22	15. 34	6	12. 38	19	0 · 33	30
15	5 · 49	0	1 · 36	16	8 · 30 Subſtract	20	15 40 Subſtract	6	12 19 Subſtract	19	1 · 03	30
16	5 · 49 Add	0	1 · 20	16	8 · 50	19	15 46	5	12 00	21	1 · 33	29
17	5 · 49	1	1 · 04	17	9 · 09	20	15. 51	4	11. 39	21	2 · 02	30
18	5 · 48	1	0 · 47	17	9 · 29	19	15. 55	3	11. 18	22	2 · 32	29
19	5 · 47	2	0 · 30	18	9 · 48	18	15. 58	2	10. 56	22	3 · 01	30
20	5 · 45	2	0 · 12 *	17	10. 6	19	16. 00	2	10. 34	23	3 · 31	29
21	5 · 43	3	0 · 05	19	10. 25	19	16. 02	1	10. 11	24	4 00	28
22	5 · 40	4	0 · 24	19	10. 44	19	16. 03	1	9 · 47	24	4 28 Add	28
23	5 · 36	4	0 · 43	20	11. 03	17	16. 04	0	9 · 23	24	4 · 56	27
24	5 · 32	4	1 03	19	11. 20	17	16. 04	2	8 · 59	25	5 · 23	27
25	5 · 28	6	1 22 Subſtract	19	11. 37	17	16. 02	3	8 · 34	26	5 · 50	27
26	5 · 22	7	1 41	19	11. 54	17	15. 59	3	8 · 08	27	6 · 17	27
27	5 · 15	7	2 · 00	20	12. 11	16	15. 56	4	7 · 41	26	6 · 44	26
28	5 · 08	8	2 · 20	20	12. 27	16	15. 52	5	7 · 15	27	7 · 10	26
29	5 · 00	7	2 · 40	20	12. 43	16	15. 4[illegible]	6	6 · 48	29	7 · 36	24
30	4 · 53	8	3 · 00	20	12. 59		15. 41	7	6 · 19		8 · 00	24
31	4 · 45		3 · 20				15. 34				8 · 24.	

CALCULATION
OF
Hours and Minutes for an HORIZONTAL-DIAL.

DUBLIN Lat. 53°. 20′.

Calculation of Hours and Minutes for an Horizontal Dial.

Dublin Lat: 53° 20′.

Time from Noon	Hour dift. on the Plain	Time from Noon	Hour dift. on the Plain	Tme from Noon	Hour dift. on the Plain	Time from Noon	Hour dift. on the Plain
h ′	o ′	h ′	o ′	h ′	o ′	h ′	o ′
XII. 00	00 . 00	XII. 30	6 . 1	I. 00	12 . 8	I. 30	18 . 23
1	0 . 12	31	6 . 14	1	12 . 20	31	18 . 35
2	0 . 24	32	6 . 26	2	12 . 33	32	18 . 48
3	0 . 36	33	6 . 38	3	12 . 45	33	19 : 1
4	0 . 48	34	6 . 50	4	12 . 57	34	19 . 14
5	1 : 0	35	7 . 2	5	13 . 9	35	19 . 27
6	1 . 12	36	7 . 14	6	13 . 22	36	19 . 39
7	1 . 24	37	7 . 27	7	13 . 34	37	19 . 52
8	1 . 36	38	7 . 39	8	13 . 47	38	20 . 4
9	1 . 48	39	7 . 51	9	13 . 59	39	20 . 17
10	2 . 0	40	8 . 3	10	14 . 11	40	20 . 30
11	2 . 12	41	8 . 15	11	14 . 24	41	20 . 43
12	2 . 25	42	8 . 28	12	14 . 37	42	20 . 56
13	2 . 37	43	8 . 39	13	14 . 49	43	21 . 9
14	2 . 49	44	8 . 51	14	14 . 1	44	21 . 22
15	3 . 1	45	9 . 4	15	15 . 14	45	21 . 35
16	3 . 13	46	9 . 16	16	15 . 26	46	21 . 48
17	3 . 25	47	9 . 28	17	15 . 39	47	22 . 1
18	3 : 37	48	9 . 40	18	15 . 51	48	22 . 14
19	3 . 49	49	9 . 52	19	16 . 4	49	22 . 27
20	4 . 1	50	10 . 5	20	16 . 17	50	22 . 40
21	4 . 13	51	10 . 17	21	16 . 29	41	22 . 53
22	4 . 25	52	10 . 29	22	16 . 41	52	23 . 6
23	4 . 37	53	10 . 42	23	16 . 54	53	23 . 19
24	4 . 49	54	10 . 54	24	17 . 7	54	23 . 32
25	5 . 1	55	11 . 6	25	17 . 20	55	23 . 45
26	5 . 13	56	11 . 18	26	17 . 32	56	23 . 58
27	5 . 25	57	11 , 31	27	17 . 45	57	24 . 11
28	5 . 37	58	11 . 43	28	17 . 57	58	24 . 24
29	5 . 49	59	11 . 55	29	18 . 10	59	24 . 38
30	6 . 1	60	12 . 8	30	18 . 23	60	24 . 51

Calculation of Hours and Minutes for an Horizontal Dial.

Dublin Lat: 53° 26'.

Time from Noon	Hour dist. on the Plain	Time from Noon	Hour dist. on the Plain	Time from Noon	Hour dist. on the Plain	Time from Noon	Hour dist. on the Plain
h '	° '	h '	° '	h '	° '	h '	° '
II.00	24 . 51	II.30	31 . 37	III. 00	38 . 44	III. 30	46 . 16
1	25 . 5	31	31 . 51	1	38 . 59	31	46 . 32
2	25 . 18	32	32 . 4	2	39 . 14	32	46 . 47
3	25 . 31	33	32 . 18	3	39 . 28	33	47 . 3
4	25 . 44	34	32 . 32	4	39 . 43	34	47 . 19
5	25 . 57	35	32 . 46	5	39 . 57	35	47 . 35
6	26 . 10	36	33 . 0	6	40 . 12	36	47 . 50
7	26 . 24	37	33 . 14	7	40 . 27	37	48 . 5
8	26 . 38	38	33 . 28	8	40 . 42	38	48 . 21
9	26 . 51	39	33 . 43	9	40 . 57	39	48 . 37
10	27 . 4	40	33 . 57	10	41 . 12	40	48 . 53
11	27 . 18	41	34 . 11	11	41 . 27	41	49 . 9
12	27 . 31	42	34 . 25	12	41 . 42	42	49 . 25
13	27 . 44	43	34 . 39	13	41 . 57	43	49 . 40
14	27 . 58	44	34 . 53	14	42 . 12	44	49 . 56
15	28 . 11	45	35 . 8	15	42 . 27	45	50 . 12
16	28 . 25	46	35 . 22	16	42 . 42	46	50 . 28
17	28 . 39	47	35 . 36	17	42 . 57	47	50 . 44
18	28 . 52	48	35 . 50	18	43 . 12	48	51 . 0
19	29 . 6	49	36 . 5	19	43 . 27	49	51 . 16
20	29 . 19	50	36 . 19	20	43 . 42	50	51 . 33
21	29 . 33	51	36 . 34	21	43 . 57	51	51 . 49
22	29 . 47	52	36 . 48	22	44 . 13	52	52 . 5
23	30 . 0	53	37 . 2	23	44 . 29	53	52 . 21
24	30 . 14	54	37 . 17	24	44 . 44	54	52 . 37
25	30 . 28	55	37 . 31	25	44 . 59	55	52 . 54
26	30 . 41	56	37 . 46	26	45 . 15	56	53 . 10
27	30 . 55	57	38 . 0	27	45 . 30	57	53 . 26
28	31 . 9	58	38 . 15	28	45 . 45	58	53 . 43
29	31 . 23	59	38 . 29	29	46 . 1	59	53 . 59
30	31 . 37	60	38 . 44	30	46 . 16	60	54 . 15

Calculation of Hours and Minutes for an Horizontal Dial:

Dublin Lat: 53° 20′.

Time from Noon	Hour diſt. on the Plain		Time from Noon	Hour diſt. on the Plain		Time from Noon	Hour diſt. on the Plain		Time from Noon	Hour diſt. on the Plain	
h ′	°	′	h ′	°	′	h ′	°	′	h ′	°	′
IIII. 00	54	15	IIII. 30	62	42	V. 00	71	32	V. 30	80	40
1	54	32	31	62	59	1	71	50	31	80	59
2	54	48	32	63	6	2	72	8	32	81	18
3	55	5	33	63	33	3	72	26	33	81	37
4	55	21	34	63	51	4	72	44	34	81	55
5	55	37	35	64	8	5	73	2	35	82	14
6	55	54	36	64	26	6	73	20	36	82	32
7	56	11	37	64	43	7	73	38	37	82	51
8	56	28	38	65	1	8	73	56	38	83	9
9	56	45	39	65	18	9	74	14	39	83	28
10	57	1	40	65	36	10	74	33	40	83	47
11	57	18	41	65	53	11	74	51	41	84	5
12	57	35	42	66	11	12	75	9	42	84	24
13	57	51	43	66	28	13	75	28	43	84	43
14	58	8	44	66	46	14	75	46	44	85	2
15	58	25	45	67	4	15	76	4	45	85	20
16	58	42	46	67	22	16	76	23	46	85	38
17	58	59	47	67	39	17	76	41	47	85	57
18	59	16	48	67	57	18	76	59	48	86	16
19	59	32	49	68	14	15	77	17	49	86	34
20	59	49	50	68	32	20	77	36	50	86	53
21	60	7	51	68	50	21	77	55	51	87	11
22	60	24	52	69	8	22	78	13	52	87	31
23	60	41	53	59	26	23	78	31	53	87	50
24	60	58	54	69	44	24	78	50	54	88	9
25	61	15	55	70	2	25	79	8	55	88	28
26	61	32	56	70	20	26	79	27	56	88	47
27	61	50	57	70	38	27	79	45	57	89	6
28	62	7	58	70	56	28	80	4	58	89	25
29	62	24	59	71	14	29	80	22	59	89	44
30	62	42	60	71	32	30	80	40	60	90	00

A Table of the moſt noted *Circumpolar-Stars*, or thoſe that ſet not in the *Lat.* 53°. 20′. for ſhewing the time of Night by a Line and Plummet, to the year 1680, and ſerves for 20 years to come.

Mag	Stars Names.	Rt. Aſcenſion in Time under the Pole-ſtar	Diff. in Time betwixt the poleſtar & pole	Azimuth under the Pole-ſtar	Coaſt
		H ′ ″	H ′ ″	° ′ ″	
	Urſa Major				
2	*On his Back*	00.03.53	0 .04.26	0 .37.12	E
3	*Penult in Dracos Tail*	00.20.17	0 .03.19	0 .19.12	E
2	*Cor Caroli*	00.36 44	0 .0 .05	0 :00.54	E
2	*His Rump Aliot*	00.39.25	0 .0 .14	0 .02.06	W
2	*Middle of its Tail*	01.07.02	0 .03 44	0 .33.00	W
2	*End of the Tail*	01.28.56	0 .05.49	0 .57.00	W
2	*Laſt but two in Dracos Tail*	01.47.40	0 .10 58	1 .16.48	W
	Urſa Minor				
2	*Higher Guard*	02.26.05	0 .24 10	1 .55.48	W
3	*Lower Guard*	02.57.15	0 .26.50	2 .24.36	W
	Draco				
3	27 *in Ticho's Cat.*	02.59 49	0 .18.01	2 .27.00	W
3	26	03.35.17	0 .21.04	2 .55.48	W
3	25	03.54.54	0 .24.39	3 .10.12	W
3	20	03.58.34	0 .30.43	3 .12.36	W
3	24	04.36.43	0 .30.49	3 .34.48	W
3	*Firſt in the Head*	04.59.30	0 .23.42	3 .45.00	W
2	*Bright in the Head*	05.25.01	0 .24.11	3 .53.24	W
1	*Lucida Lyra*	06.05.34	0 .20.30	4 :00.36	W

		H ' "	H ' "	° ' "	
3	*N. in the upper turn*	06.37.04	0 .35.44	4 .01.12	w
3	*S. in the upper turn*	07.11.22	0 .37.56	3 .56.24	w
	Cygnus				
3	*Upper Wing*	07.13.26	0 .21.49	3 .56.24	w
3	*Her Breſt*	07.51.26	0 .19.20	3 .45.00	w
4	*N. Cepheus R. Arm*	07.55.07	0 .28.46	3 .44.00	w
2	*Swans Tail*	08.10.30	0 .19.59	3 .37.12	w
	Cepheus				
4	*S. on his R. Arm*	08.11.32	0 .26.57	3 .36.36	w
2	*Right ſhoulder*	08.45.35	0 .25.02	3 .18.36	w
3	*His Girdle*	08.53.30	0 .30.44	3 .13.48	w
4	*N. in his Cap*	09.41.52	0 .18.16	2 .40.48	w
4	*Before his Head*	10.09.17	0 .15.56	2 .19.12	w
4	*Left ſhoulder*	10.20.44	0 .17.48	2 .09.36	w
3	*His Knee*	11.10.00	0 .17.59	1 .25.48	w
	Caſſiopea				
3	*Her Chair*	11.46.07	0 .05.54	0 .51.00	w
4	*Seat of the Chair*	12.11.48	0 .03.14	0 .25.48	w
4	*Head*	12.17.20	0 .02.07	0 .20.24	w
3	*Breſt*	12.20.48	0 .01.50	0 .16.48	w
4	*Girdle*	12.28.46	0 .00.59	0 .09.00	w
3	*Hipp*	12.37.50	0 .00.02	0 .00.10	w
3	*Knee*	13.08.45	0 .03.41	0 .31.12	E
3	*Legg*	13.39.38	0 .07.53	1 .01.12	E
2	*Foot of Androm.*	13.50.37	0 .06.19	1 .12.00	E

	Perſeus	H ′ ″	H ′ ″	° ′ ″	
4	*Left ſhoulder*	14.33.38	0 .10.52	1 .51.36	E
3	*Bend of his ſide*	14.43.40	0 .11.03	2 .00.36	E
3	*Right ſhoulder*	14.55.31	0 .13.42	2 .10.48	E
3	*Meduſa's Head*	14.59.14	0 .11.45	2 .13.[illegible]	E
2	*Bright * in his ſide*	15.14.59	0 .14.29	2 .26.24	E
4	*Left Thigh*	15.37.56	0 .14.35	2 .44.24	E
3	*Left Knee*	15.51.39	0 .14.57	2 .54.36	E
4	*Before his Right Knee*	16.01.08	0 .18.05	3 .00.36	E
4	*Middle of his Right Knee*	16.09.47	0 .18.06	3 .06.36	E
	Auriga				
4	*Left Elbow*	16.58.15	0 .19.27	3 .33.36	E
1	*Capella*	17.13.55	0 .20.4[illegible]	3 .40.48	E
2	*Right ſhoulder*	17.58.07	0 .21.55	3 .55.12	E
	Urſa Major				
4	*His Lipp*	20.31.52	0 .27.38	3 .37.48	E
3	*N. in his Right Foot*	20.50.49	0 .20.53	3 .28.12	E
3	*S. in the ſame*	20.55.23	0 .20.13	3 .21.00	E
3	*Left Knee*	21.24.15	0 .19.57	3 .07.12	E
4	*Higher in his hind Foot*	22.11.32	0 .13.56	2 .30.36	E
2	*Lower Leader in* □	22.54.50	0 .12.57	1 .50.24	E
2	*Higher Leader*	22.57.59	0 .14.20	1 .47.24	E
3	*Laſt in Draco's Tail*	23.24.13	0 .13.36	1 .20.24	E
2	*Bears Left Thigh*	23.43.36	0 .06.38	0 .59.24	E

FINIS.